NOTE

This Microfiche meets the quality requirements of the American National Standard for Microfiche of Documents (ANSI PH5.9-1975). However, because of imperfections in the document from which it was made, it contains images that are illegible or difficult to read. The source document for this microfiche is the best copy that could be obtained prior to filming.

Congressional Information Service, Inc
Washington, D.C

CRITICAL NEED FOR ENERGY RESEARCH AND DEVELOPMENT: THE ROLE OF THE MIDWEST RESEARCH LABS

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENERGY, NUCLEAR PROLIFERATION, AND
GOVERNMENT PROCESSES

OF THE

COMMITTEE ON
GOVERNMENTAL AFFAIRS
UNITED STATES SENATE

NINETY-SEVENTH CONGRESS

SECOND SESSION

MARCH 22, 1982
ARGONNE, ILLINOIS

Printed for the use of the Committee on Governmental Affairs

11-308 O

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1982

S401-83

COMMITTEE ON GOVERNMENTAL AFFAIRS

WILLIAM V. ROTH, Jr., Delaware, *Chairman*

CHARLES H. PERCY, Illinois
TED STEVENS, Alaska
CHARLES McC. MATHIAS, Jr., Maryland
JOHN C. DANFORTH, Missouri
WILLIAM S. COHEN, Maine
DAVID DURENBERGER, Minnesota
MACK MATTINGLY, Georgia
WARREN B. RUDMAN, New Hampshire

THOMAS F. EAGLETON, Missouri
HENRY M. JACKSON, Washington
LAWTON CHILES, Florida
SAM NUNN, Georgia
JOHN GLENN, Ohio
JIM SASSER, Tennessee
DAVID PRYOR, Arkansas
CARL LEVIN, Michigan

Joan M. McEntee, *Staff Director*
Ira S. Shapiro, *Minority Staff Director and Chief Counsel*

Subcommittee on Energy, Nuclear Proliferation, and Government Processes

CHARLES H. PERCY, Illinois, *Chairman*

DAVID DURENBERGER, Minnesota
WILLIAM S. COHEN, Maine
MACK MATTINGLY, Georgia

JOHN GLENN, Ohio
HENRY M. JACKSON, Washington
CARL LEVIN, Michigan

William A. Strauss, *Chief Counsel and Staff Director*
Howard S. Marks, *Professional Staff Member*
Leonard Weiss, *Minority Staff Director*
Kathryn H. Froelich, *Chief Clerk*

CONTENTS

Page
Opening statement of Senator Percy ---------- 1

WITNESSES

MONDAY, MARCH 22, 1982

Malcolm Baldrige, Secretary of the Department of Commerce ---------- 5
James R. Thompson, Governor of the State of Illinois ---------- 14
Alvin W. Trivelpiece, Director, Office of Research, Department of Energy ---------- 20
Abner S. Ganet, mayor, Elmhurst, Ill ---------- 35
Springfield, Ill ---------- 41
Diana Nelson, State Representative, 6th District of Illinois ---------- 42
Stanley O. Ikenberry, president, University of Illinois, Urbana, Ill ---------- 44
John J. Nimrod, vice chairman, Illinois Energy Resources Commission,
John Todd Wilson, president (emeritus), the University of Chicago, Chicago, Ill ---------- 48
Bruno A. Boley, dean, Technological Institute, Northwestern University, Evanston, Ill ---------- 54
Wallace B. Behnke, Jr., vice chairman, Commonwealth Edison Co., Chicago, Ill ---------- 56
Joseph S. Spivey, president, Illinois Coal Association ---------- 60
Robert Pry, executive vice president, Research and Development, Gould Inc., Rolling Meadows, Ill ---------- 63
Walter E. Massey, Director, Argonne National Laboratory, Argonne, Ill ---------- 66
Leon M. Lederman, Director, Fermi National Accelerator Laboratory, Batavia, Ill ---------- 87
Robert S. Hansen, Director, Ames Laboratory, Ames, Iowa ---------- 101
David N. Edgington, Director, Center for Great Lakes Studies, Milwaukee, Wis ---------- 111

ALPHABETICAL LIST OF WITNESSES

Baldrige, Malcolm:
  Testimony ---------- 5
  Letter from James B. Edwards, Secretary, Department of Energy, to Senator Percy, March 19, 1982 ---------- 5
Behnke, Wallace B., Jr.:
  Testimony ---------- 56
  Prepared statement ---------- 58
Boley, Bruno A.:
  Testimony ---------- 54
  Prepared statement ---------- 55
Edgington, David N.:
  Testimony ---------- 111
  Prepared statement ---------- 114
Ganet, Abner S.:
  Testimony ---------- 35
  Prepared statement ---------- 36
Hansen, Robert S.:
  Testimony ---------- 101
  Prepared statement ---------- 103
Ikenberry, Stanley O.:
  Testimony ---------- 44
  Prepared statement ---------- 46

Page

Lederman, Leon M.:
  Testimony 87
  Prepared statement 90
Massey, Walter E.:
  Testimony 66
  Prepared statement 70
Nelson, Diana:
  Testimony 42
  Prepared statement 42
Nimrod John J.: Testimony 41
Pry, Robert: Testimony 63
Spivey, Joseph S.:
  Testimony 60
  Prepared statement 62
Thompson, James R.: Testimony 14
Trivelpiece, Alvin W.:
  Testimony 20
  Prepared statement 27
Wilson, John Todd:
  Testimony 48
  Statement of Hanna Holborn Gray, president, the University of Chicago 51

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

Letter from Senators Percy, Durenberger, Cohen, Glenn, Jackson, and Levin to Kenneth M. Duberstein, Assistant to the President for Legislative Affairs, March 22, 1982 34
Letter from Senator Percy to James B. Edwards, Secretary, Department of Energy, March 19, 1982 68
Statement of Jane M. Byrne, mayor, city of Chicago, Ill 121
Statement of Barbara Bannon-Harwood, member, Standing Committee on Energy, National Association of Homebuilders, with an attachment 122
"Long-Term Economic Rx: Research," article by Senator Glenn, Science magazine, March 26, 1982 123
Letters to Senator Percy from:
  Downers Grove, Ill., Jon D. Council, mayor 125
  DuPage Board of Realtors, Wheaton, Ill., Philip H. Madell, executive vice president 127
  Moraine Valley Community College, Palos Hills, Ill., Byron Kee, vice president for instruction 128
  Naperville, Ill., Chester J. Rybicki, mayor 129
  Willowbrook, Ill., Edwin C. Schmittschmitt, president, with an enclosure 131

CRITICAL NEED FOR ENERGY RESEARCH AND DEVELOPMENT: THE ROLE OF THE MIDWEST RESEARCH LABS

MONDAY, MARCH 22, 1982

U.S. SENATE,
SUBCOMMITTEE ON ENERGY, NUCLEAR
PROLIFERATION, AND GOVERNMENT PROCESSES,
COMMITTEE ON GOVERNMENTAL AFFAIRS,
Argonne, Ill.

The subcommittee met, at 9:15 a.m., in the Cafeteria Building, Argonne National Laboratory, Argonne, Ill., Senator Charles H. Percy (chairman of the subcommittee) presiding.

Present: Senator Percy.

Staff present: William A. Strauss, chief counsel and staff director; and Howard S. Marks, professional staff member.

OPENING STATEMENT OF SENATOR PERCY

Senator PERCY. I am pleased to call to order this official hearing of the Subcommittee on Energy, Nuclear Proliferation, and Government Processes, of the Committee on Governmental Affairs of the U.S. Senate. Prior to the start of this U.S. Senate hearing held here today, Governor Thompson and I officiated at dedicating the new Argonne High-Sulfur Dry Scrubber. This radical and important development will be, possibly, to coal what the chain reaction was under Stagg Field—when I would walk over to swim at Bartlett Gymnasium in the forties, not realizing what was going on there. But this great development will do for Illinois coal what I think is needed. We have, here in Illinois, the "Saudi Arabia" of coal, and yet, it is a high sulfur coal. Illinois coal can now be more economically burned in the Midwest than Western coal. We can become less dependent upon oil; and, certainly, the only high sulfur dry scrubber in the world, developed right here at Argonne Laboratory, will enable us to meet environmental standards here in this country and around the world. It's a fitting day to dedicate a breakthrough in technology that will be extremely important for the future.

We, in the Senate, have the responsibility to bring national issues to local audiences for their input. I've not felt that it is always necessary for people to come down to Washington to testify, and this is the ninth hearing of this U.S. Senate subcommittee that we've held, in the past year or two, in Illinois. Otherwise, I think we could make some major policy mistakes—the kind that we do not want to see the administration make in dangerously reducing support for Federal research programs.

I've been concerned about the level of our research and development expenditures for a long time. When I became a member of the Space Committee of the U.S. Senate, I was extremely disturbed, as a former industrialist, to see the gyrating way that we did our budgets. I know what it does to an engineering and scientific and technical organization when you gyrate programs by projects, building up and down, tearing down organizations that have been developed. At that time, we developed a steady, ongoing budget for NASA that I think has far more efficiently and effectively spent our funds. And, certainly, the launch, underway today, is an example of what has been accomplished in that field.

When I proposed originally, to Dr. Massey, that we hold a field hearing of the Governmental Affairs Committee of the U.S. Senate on the topic of research and development at the Argonne Laboratory, I was delighted that he accepted so readily and has provided these fine facilities to us. I think the interest in this hearing alone, which probably is 10 to 20 times larger than any hearing I've attended in the smaller quarters in Washington, is an indication that it is a good decision to come out to Illinois, the "Heartland of America," for this particular hearing.

The United States has always been the world's leader in science and technology. Our lead is now contested, and we're in very real danger of falling behind other nations. I'm alarmed, and I believe all Americans should be also by these disturbing facts:

One, last year, U.S. colleges granted 58,000 engineering degrees. In Japan, with half the population, 74,000 engineering degrees were conferred;

Two, in the United States, only one out of every six high school students takes both math and science courses during his or her 4-year term. In Japan, West Germany, and most other advanced countries, the intensive study of math and science is compulsory;

Three, right now, 22 percent of all high school math teaching positions are vacant in the United States;

Four, in 1979, 39 percent of all U.S. patents were issued to foreign companies; and

Five, finally, during the past 14 years, nonmilitary research and development rose only 10 percent in the United States, while it rose 30 percent in West Germany and 25 percent in Japan. Perhaps this explains why Japan showed a 290 percent gain in manufacturing productivity over that span, while the United States boosted productivity by only one-tenth of the amount that Japan did.

Unless the United States gets moving, we could someday find ourselves a second-rate economic power. Since our productive economy is the basis of our greatness as a nation, its decline could mean the beginning of the end of the United States as the world's greatest power. Let us hope that the current crisis will shake us out of the doldrums of lagging productivity like Sputnik destroyed our scientific complacency 20 years ago.

I firmly believe that both basic and applied research can lead to better ways of doing things through greater understanding of the world around us. This is the key to improving our productivity and restoring the economic health of the Nation and the Midwest. A major role in this effort should be vested with the great laboratories represented here today.

Some say that the Federal Government has no role in revitalizing the Midwest, and that we simply have to let the chips fall where they may. I say, quite the contrary, that if we continue to let the Midwest decline, the ultimate human and economic cost to the entire Nation will be much higher.

Frankly, I believe we may be in danger of making our problem worse by spending an increasing amount of midwestern tax dollars outside of the region. For instance, in fiscal year 1980 for every dollar that Illinois taxpayers paid to support the Federal defense budget, we got back only 35 cents. In Wisconsin, it was 20 cents. In Iowa, it was 28 cents. Compared with California which got back $1.75, and New Mexico, where DOE is threatening to send some important Argonne project, got back almost $3 of every tax dollar earmarked for defense.

We have long known that about 90 percent of all of the Ph. D's we train here in Illinois go to other States to seek their profession. This is simply wrong, and one of the reasons that the Midwest has been declining. We, in Congress, who represent this region, must say that we simply find intolerable the continuation of such imbalance in the places our Federal tax dollars are spent. Furthermore, in the case of R&D in such areas as metallurgy and energy conservation, it simply makes sense to develop it in the industrial region where it most likely will be used—the Midwest, in other words. R&D means far more than the activities of scientists and labs. It is nothing less than the future of the Nation.

And whatever questions may be raised during the course of these hearings or by this hearing, there is one question that really must dominate all of our thinking and all of our proceedings and the actions we take in Washington: What nation will lead the world in the future? We grew up in an America where the answer to that question was really never in doubt. We grew up in an America that had infinite faith in progress, and in a prosperity that could embrace every citizen. We grew up in an America that tackled problems with vigor, and still had the energy to look for new challenges. We grew up in an America that honored her laureates and luminaries for their dreams and astonishing accomplishments. We grew up in an America that knew only the limits of imagination and hard work. I think that we believe in that kind of America. We believe that that kind of America is essential to the future of the free world.

I'd like to assure all of you who have been thoughtful enough to be with us today of one thing: That, on the achievements of the future, on the technologies that will heal and feed and employ our citizens, on the ideas that will embrace our land with confidence and security, I'd like to see stamped—for all the world to see—the label, once again, "Made in America." And to that end, you have been invited here as witnesses, a distinguished panel of witnesses; you have been invited here as guests, and this is the most distinguished guest group that any panel of the U.S. Senate has ever had at any hearing in my memory. And certainly, I want to pledge to you that I will be the witness for you in Washington, before the executive branch of government and before my colleagues, to represent everything that Illinois stands for and what we bring out in the truth of these hearings today and the facts that we'll be dealing with. I'll do that, arm-in-arm with the Governor of the State of Illinois, Jim Thompson.

We're very honored—indeed, singularly honored—to have, as our first witness, Malcolm Baldrige, the Secretary of Commerce. This is the department, the Department of Commerce, that would have the statutory responsibility for the work to be carried on in the field of energy in our national laboratories if the President's program for restructuring the Department of Energy is approved by Congress. It is this committee, the Governmental Affairs Committee, on which I have served as ranking Republican for a number of years, that had the responsibility for creating the Department of Energy and making it a statutory department. It is this committee, and it is only the Congress that has the authority to then redo the legislation that created the Department and conform it with the request of the President. Hearings on that will be held very soon indeed. Under the proposed reorganization of the Energy Department, the funding for the national laboratories would be shifted to the Commerce Department through the Energy Research Technology Administration.

Our distinguished guest today, and lead-off witness, Secretary Mac Baldrige, was born right here in the Midwest, in Omaha, Nebr., where, among many other things, he won awards on the rodeo circuit as a steer roper. I knew him, not in that capacity, but as a great industrialist. He was chairman of the Scovill Corp., and he well understands, through years of activity in business and industry, the importance of research and development. He knows from that first-hand experience in business and in Government that the difference between a great company and a company that is in decline can be the difference in the way they approach their research and development and product development, and he knows that the same thing can happen to a great country. Let's say at the outset, at this point, that I actually have not made up my mind or declared, as the Secretary knows, how I will treat the reorganization of the Department of Energy. I have said to the Secretary that, and also to Secretary Edwards, that a large part of my mind will be determined based upon the set of priorities that we intend to place as an administration, and where this money should go and how it should be spent and how it should be organized. I have received a better assurance, reassurance, from a number of key concerns; one of which is the continuation of critical energy R&D programs. And, as a result of some of these hearings that we'll be holding, this one being the first and others to follow, I will make a judgment as to how we should proceed with this legislation. I am confident, however, that the administration will treat Argonne and other Midwest labs fairly, and maintain the vital national research institutions that they are.

Secretary Baldrige, we warmly welcome you to Illinois, and look forward to your testimony.

TESTIMONY OF MALCOLM BALDRIGE, SECRETARY OF THE DEPARTMENT OF COMMERCE

Mr. BALDRIGE. Thank you, Senator. I want to say first that, except for your overly kind remarks about me, I subscribe to everything, I heard you say. You are too rare, unfortunately—a successful ex-businessman who has made, and is continuing to make, a successful career in government. We have a great many lawyers in the U.S. Senate; I wish we had some more ex-businesssmen. You know, Senator, one of the statistics that you quoted—the number of engineering graduates per year in Japan versus in the United States, about four times the number we graduate on a per capita basis—leads me to think of another statistic—the U.S. graduates 20 times as many lawyers as Japan does. I think that both these statistics contribute to the difficulties we're seeing.

I am pleased to be at this world-famous national laboratory to participate in the subcommittee's hearings on energy research and development, and specifically on the role of the Midwest's national labs in that R&D effort. Secretary of Energy James Edwards has asked me to express his regrets that he could not be here today. He asked that a letter, from him, to Senator Percy, be accepted for the record.

[The letter referred to follows:]

DEAR SENATOR PERCY: As you know, I will not be able to attend the hearings scheduled at Argonne National Laboratory on March 22. Al Trivelpiece, DOE's Director of Energy Research, will represent me. He shares my belief that maintaining a strong and viable national R&D laboratory resource is essential to assure our economic, scientific, and national security positions.

Argonne National Laboratory, Ames, and Fermi carry out research and development activities that benefit the Nation, and are real assets to the economic strength of the region. The laboratories also serve as unique user facility centers that make research capabilities accessible to universities and the private sector, especially in the Midwest, that would not otherwise be available.

I want to reassure you that our plan for the reorganization of the Department of Energy will not impede the continued performance of research of high quality and excellence at Argonne National Laboratory, Ames, and Fermi. Decisions on funding such research will continue to be on the basis of scientific excellence and relevance. We fully expect that these laboratories will continue to play a major role in the Nation's scientific program.

Thank you for the invitation. I share your pride in Department of Energy laboratories in the Midwest as important regional and national resources.

Sincerely,

JAMES B. EDWARDS.

Mr. BALDRIGE. President Reagan has announced his intention to reorganize the Government's energy functions. As part of that reorganization, the R&D programs of the Department of Energy, including those performed by the Midwest's national laboratories—Ames, Argonne and Fermilab—would be transferred to the Department of Commerce, where they would be administered by an Energy Research and Technology Administration (ERTA). I look forward to this transfer.

Mr. Chairman, we were both chief executive officers of large corporations. I know that at Bell & Howell you had many of the same experiences that I had at Scovill, Inc. As former businesmen, we both know well the importance of research and development performed by our national laboratories to the industrial community and to the well-being of our national economy.

The Federal Government supports R&D: One, to fulfill governmental needs where the sole or primary user of the research and development is the Government itself. For example, national defense R&D and regulations R&D; and two to meet national needs where the Government, while not the sole or primary user, helps to insure the strength of the Nation's economy and the welfare of its citizens through the support of R&D in specific areas such as agriculture, health and energy.

The primary responsibility for supporting or performing research and development to meet nongovernmental national needs does not and cannot lie with the Government. The Government's primary role is to provide a climate which encourages private-sector R&D investment. The administration is fulfilling this role by reducing Government spending, regulation, and taxes.

The Government does, however, have a large secondary role: to directly support or perform nationally needed research and development where there is a substantial prospect for significant economic gain to the Nation, but where the potential gains to individual firms are too remote or speculative to foster adequate private research. Thus, the Government supports basic research across all scientific disciplines, but limits its applied research and technology development spending primarily to technologies such as fusion power, which require a long period of initial development and where both the risk and potential payoff are high.

The Government also has a responsibility that it shares with the private sector to support health, public safety, and environmental research to protect the public and the environment.

The main thrust of this administration's energy policy is to encourage the contribution of the private sector and to remove Government involvement from what should be market decisions. As Dr. Massey, the Director of Argonne, testified before the House Science and Technology Committee in July 1981, the primary national need R&D role of the national laboratories is to provide industry with information and ideas. The laboratories job regarding energy R&D is to conduct long-range, high-risk, high-potential payoff research and development in appropriate energy technologies. While the President's budget proposal contains a one-third cut in Government-sponsored energy R&D nationwide, over $2 billion would remain in the budget for such R&D.

In fiscal year 1983, ERTA will support a substantial R&D program at the national labs related to the development and testing of nuclear weapons; a significant general science program comprised largely of basic research in high-energy physics and nuclear sciences; and a broad energy program focused on long-term R&D. Consistent with the administration's projects—i.e., in fossil and solar energy—a major component of the one-third cut in energy R&D nationwide—there will be significant decreases from fiscal year 1982 in ERTA support of energy R&D at the Midwest's labs. However, those labs are receiving increases from ERTA in other R&D areas such as high-energy physics and basic-energy sciences. Increases to support long-term research in such fields as nuclear science, chemistry, engineering, material science, mathematics, biology, and geoscience will strengthen the scientific and the technical base for future advances in all energy technologies. All in all, aggregate funding for Ames, Argonne, and Fermi Labs is being cut by only $2.3 million to 0.6 of 1 percent of the aggregate Department of Energy funding level for those labs in fiscal year 1982. This is a far smaller cut than the cuts for most other primarily nondefense institutions.

The national labs which would be transferred to Commerce represent the cutting edge of high technology, an area of critical importance to the competitiveness of the United States in world markets. The Midwest's national labs provide the Nation, and particularly the great industrial heartland of our Nation, the Midwest, with unique scientific facilities and a focus for ground-breaking research. As Secretary Edwards stated in his letter, the Midwest's labs not only perform R&D for the Government that benefits the Nation but serve as user-facility centers that make research capabilities available to universities and the private sector in the Midwest that would not otherwise be available. I assure you that if the Midwest labs are placed under the Department of Commerce's stewardship, I will do everything I can to keep them strong.

I must, however, qualify that assurance in one respect. Our contractor-operated national laboratories perform programs for the Government. Program priorities change with each administration and for that matter, can change during an administration. When deciding program priorities in the President's budget, we focus on the worth and appropriateness of programs and on the effect that increases and decreases in a program's budget will have on obtaining a program's objectives. If a lab is heavily involved in areas at one time assigned a high priority and then assigned a lower priority with a corresponding programmatic budget decrease, then the lab can expect a corresponding decrease in its budget. If a lab has the competence to perform a program in an area of increased priority and there is no existing capability to perform the work in industry or academia, then the lab can expect a budget increase in that area.

Nor should we say that the roles and missions of our national laboratories will never change. The President's Office of Science and Technology Policy is carefully studying the role and mission of the labs and is examining the overall role of our labs in U.S. science and technology. I intend to work closely with that Office's Director, Dr. Keyworth, in the conduct of that study.

In this context, I believe that the Midwest's labs should continue to have a large role in the performance of this Nation's basic energy R&D. Further, they should continue to have a large role in the performance of this Nation's basic research. The fiscal year 1983 budget contains an estimated $5.8 billion to support the conduct of basic research—much of it at our national labs and universities. This represents a one-half billion dollar or 9-percent increase over 1982. For ERTA, there is a basic research increase of $94 million or about 14.5 percent.

As a former businessman, I personally believe that our national labs, including the Midwest's, should also have a significant role in the performance of research to reduce or remove technical barriers that impede the prompt introduction or exploitation of new technologies. The programs in very large-scale integrated circuits (VLSI) testing and standards development; materials science; automated manufacturing standards development; and chemical engineering at the National Bureau of Standards, a major national lab which has been in the Department of Commerce since the Bureau's creation in 1901, demonstrate my commitment to such a role.

I acknowledge and applaud the Midwest's national labs for their numerous accomplishments. I contrast their vigor and sense of purpose with the pessimism of some Americans—that our country has lost the ability to compete in world markets. You only have to look at our leadership and our ability to innovate in computers, aircraft, and aircraft engines, and in the products of our modern, increasingly technological agricultural industry, to mention a few, to know that such pessimism is not justified.

Innovation—the creation and bringing to market of new and useful products—often depends on new science and technology. In a very real sense, the future of the United Statecs depends on our ability to develop and market new technologies that have their roots in research such as that being done at the Midwest national labs.

Thank you for letting me testify today, and, thank you, Senator.

Senator PERCY. Secretary Baldrige, thank you very much indeed for your fine testimony. We could not bring into the room to show you today, the new Argonne high-sulfur dry scrubber, which may be the only high-sulphur dry scrubber in the world. But I did mention at the dedication ceremony this morning that, as a member of the President's Commission on Coal, whose chairman is Jay Rockefeller, we never, ever, as a commission, in all the years we've worked, asked the Government to reduce the standards of clean air. We weren't going to walk back. I had absolute faith that someday we'd get a break, and it's here today, and it came right from these laboratories. We now know that we can go into the program. We now know that all of this coal, high sulfur and otherwise, in the Illinois basin, is available for export, and use here, with the technology that has been developed at Argonne National Laboratories; and we will open up the greatest coal exporting program. The Governor's enthusiasm for it is very high—that I think we've seen.

Here's just one other example that could be brought in. This is the heart of a new technology developed by Argonne, a superconducting, split-ring resonator, will permit the construction of low cost, compact accelerators, one of which is under construction right here at Argonne. This new device will be able to accelerate heavy ions to high energies by using less power than it takes to actually light a Christmas tree. So we have seen great products come out of these laboratories. And now, I'd like to quickly mention that we have both had an industrial background for decades. We have both seen, sometimes, what happens in a company when a new chief executive comes in. He's 60 years old, he's going to retire at 65, the board gives him a nice stock option, and he's got 5 years to get this company as profitable as he can. So he submits a budget which cuts down maintenance, cuts down research and development, product development, and he milks the company for about 5 years. Maybe the stock does go up. But my own experience was, and our guideline was, and the rule I always had at Bell & Howell: 5 years from now, 80 percent of the product that we market then has not yet been developed. We've got to move that fast, and what we don't want is the country to ever go into this position where we short change and undercut our future by undercutting the kind of development that has made possible the launch of the Space Shuttle this morning, which should go off in just a few minutes, and I will keep you advised of this through announcements on it.

I'd like to just put this question to you, because I know that you're not going to mortgage our future; you're not going to mortgage our children and our grandchildren. I can think of no better way of assuring that the United States will be a second-rate economic and military power in the 21st century than to cut R&D in the 1980's.

Secretary Baldrige, I know that you did not propose a cutback in the Federal nondefense R&D budget. You're a well-respected Cabinet official, with the confidence of the President. How do you feel about the value of R&D as an investment for the future; as an investment that we must make today to insure the future greatness of this country?

Mr. BALDRIGE. Well, Senator, I don't think there's any question about it. We have to keep ahead of the rest of the world in research and development. I would just make the same qualification I made before. Any chief executive officer, within the framework of his budget, has to make some adjustments to reflect relevant shifts of importance. There can be some difference of opinion regarding those shifts and adjustments. But the overall issue of research and development I think we're all agreed on. I feel very strongly that we have to keep that up, and keep it up ahead of the rest of our trading competitors.

I think it is important to note that, in the President's fiscal year 1983 budget, there is a total of $43 billion for all research and development, which is an increase of about 11 percent over last year. So, overall, we are increasing the budget. Within that framework, some areas have been increased and some have been decreased. But that, again, as I have said, is a judgment call. But on your fundamental question, there is no question but that we should continually strengthen our R&D and try to keep ahead of other nations in that respect.

Senator PERCY. Last week, in the Senate, I gave a speech on the floor of the Senate to point out that one of our great industrialists that we both know well here, Lee Morgan, head of the largest manufacturing company in Illinois, the head of Caterpillar Tractor, that we can learn a great deal. Just as other countries have learned from us, we can continue to learn from them, and we ought to study carefully what's going on in Japan today.

In Japan today, government support for research include analyses of export markets and foreign technologies, deductions for industrial research, tax credits, and accelerated depreciation for R&D facilities. In West Germany, there are applied, industrial-oriented, government research institutes.

With the governments of these countries who are moving ahead so rapidly, aiding private industry, and with the recognition that in every industry you can't do applied research. They've got to draw upon a common pool. Just as we can't expect every farmer in Illinois to do his own research. That has to be done, a lot of it, by the Department of Agriculture and by our great universities. How can we effectively compete if we do not match some of these efforts being made by Japan and West Germany in R&D?

Mr. Baldrige. I think we have a tendency to forget sometimes, and this is not a chauvanistic statement, that the other fellow puts his pants on one leg at a time also. We have seen some successful efforts in Germany and Japan—there is no question about that—where their governments have performed or funded applied research for industry's benefit.

In our country, until this administration took over, the Government provided little in the way of research and development incentives. There were a lot of obstacles, but there were little incentives. As part of our economic recovery program, we've made a major change in that now. We've provided real help for companies that want to buy equipment to be used in research and development; they now have a 3-year writeoff. We've provided real help for the other R&D costs that a company has. From a base of the last 2 years, a company gets real help if it increases its research and development expenditures. Those are the kinds of things needed to spur research and development in our own industry that were not there before, that put us on a more equal footing with Japan and Germany. And, I might also say that the whole accelerated depreciation schedule, for the first time in many years is now equal to what our trading competitors give their industries. We are roughly in the same depreciation ball park as Japan and Germany.

All those together mean that the roadblocks to private R&D have been, by and large, removed, and the private sector should be able to take over some of the kinds of research that the Government is doing now, because they have incentives for so doing, and actually make applied use of that research, I think, better than the Government can in most cases. So, we're talking, really, about not a question of doing away with the research, but about trying to make an orderly shift, where it is appropriate, from the Government to the private sector, because, eventually, it has to end up there anyway. There may be, along the road, some differences of opinion about just how fast we are going or what should be done. But you can see that the underlying effort is there to do applied research, but to try and shift more of it to the private sector.

Senator Percy. Let me just take one area where the private sector is doing a lot, but I do think that more can be done centrally, more efficiently than any other way; and that is "Energy Conservation", which is a subject you and I have talked about many times. I felt so strongly about it that, together with Hubert Humphrey, we founded the Alliance To Save Energy, a private-sector, nonprofit organization. One hundred and seventy members of Congress are representatives of it. We have a cross section of the strongest board, probably in the United States of America; industrialists, labor leaders, conservationists, and you serve as one of several Cabinet officials who are consultants. We just decided to concentrate on that. We felt we had to deregulate the price of oil to get oil priced at world prices, not at regulated prices. Together we've worked on this so that we've now brought imports down from 8½ million barrels a day to, just as this present time, about 5 million barrels, even a greater economic activity, and we've got a long way still to go.

But, despite the biggest payoff, sometimes $2 and $3 dollars a barrel expenditure equivalent, to save energy through more efficiency, the budget has been cut 97 percent. The challenge we send to you, as the potential future new head of this Department, is to create the new techniques and new ideas to be used by everyone. I don't know how you're going to do it with a budget that's been cut 97 percent. Can you use your considerable influence with the administration to have them take another look at that and see whether or not their priorities aren't askew, and whether or not we shouldn't get back the kind of investment we can. These laboratories have been working in this field efficiently, effectively, and well, not only here in conservation, but renewable resources that will, I think, be a better source of energy for the future. Can you help us on that?

Mr. **Baldrige.** Senator, I'll be glad to review this and keep you up to date. There is some difference of opinion, as you know, and that is why the subject comes up today. You can plot a very definite symmetrical curve between the price of energy and its usage in this country. You can plot the same kind of a curve between the price of gasoline and the sale of small cars—not the production, but the sale of small cars. It is a very interesting curve. In the sixties and seventies, the U.S. automobile companies—and I am not trying to relieve them of all blame for what happened in the sixties and seventies—tried three different times to bring out generations of small cars. And every time they did, action by the U.S. Government to keep the price of gasoline down through keeping the price of oil down, thwarted their efforts. So that when the price of energy finally did start to go up, we were ill-prepared. That was not completely the fault of the automobile companies. I'd say it was more the fault of the U.S. Government in keeping energy prices artificially low, when, around the world, they were high, and that gave our automobile competitors around the world a head start.

I think there is a correlation, definitely and obviously, between what people pay for the price of energy and how far they go in making their own efforts to conserve it. How much further we should go as a government is an open question in my mind. I promise to review that issue, because the matter is not settled in my own mind. I do have an open mind on this issue.

Senator **Percy.** Thank you very much.

I talked, last night, to Senator Schmitt, down in Florida, a former astronaut, and Barry Goldwater, a ranking member of the Space Committee. They are coming over to celebrate, at the house for dinner tonight back in Washington, the successful launch of *Columbia.* We are—just one second before I tell you whether it was successful or not. I'm happy to announce that the *Columbia* successfully launched at 10 a.m. [Applause.]

Now to get down to a more mundane, here-on-Earth or below-Earth subject. Coal companies, and certainly Illinois and the Illinois basin I know best, want to do everything they can in the way of technology. They have been extraordinarily cooperative. When we have half of the land mass of the United States, 9 of 18 million-acres of prime farmland with coal under it, they've been extraordinarily helpful in saying, "We're not going to destroy that farmland; we're going to restore it," and so forth. They do not have the physical resources, the financial resources and the development resources, however, to do all that is necessary to reduce the sulfur level of Illinois-basin coal. And that's why, for centuries, it's just been lying here and not really been mined to its capacity. We now see the light. We've dedicated, today, an instrument and development that can really help that a great deal.

I know, Mr. Secretary, you have appointed a high-level task force within your department to promote the export of coal. Yet, the Federal Government appears to be terminating its research efforts that would help make Illinois coal a more attractive export. I just can't agree with that position as a member of the export commission, on which we've both served. I just feel that, just as in agriculture, Government has had to play a role, which has been pre-eminent in keeping us the most productive Nation on Earth in the production of food; we can take that same position in coal. The coal companies are really looking to the Government to provide this basic research, to provide leadership in this area. Governor Thompson is providing it here in Illinois; we trust the Reagan administration will in Washington.

Given that you are in the coal-production business and in the promotion business, wouldn't it appear to you that we may be hurting our credibility with potential buyers all over the world when we propose, now, to cut back on the very R&D programs that could make American coal more salable, not only in this country, but abroad as well?

Mr. **Baldrige**. It depends on the programs. The Energy Department has not been transferred to the Department of Commerce yet; that is in the hands of the Congress. I cannot pretend to have studied every one of the fossil-fuel programs. I do know that, in our efforts in the Commerce Department to increase exports and study where increased exports would come from, we have targeted coal as potentially the biggest single export increased dollar-earner in the next decade. That is to say, we can increase more in coal in dollar exports in the next decade than we can in any other single area, and that is the measure of importance with which we view that. I'm not prepared, today, to talk about each one of the programs. I think that the high-sulfur coal problem needs to be solved, but I don't think the coal companies can do that single-handedly, there's no question in my mind about that. But I can't speak for the administration on that specific point, because I'm not empowered to. But I do think that coal is of such importance to us that I would certainly not want to do anything to hurt our ability to export coal.

Senator **Percy**. Secretary Baldrige, I don't agree with the administration's R&D priorities, but let's go beyond that issue for a moment. From our shared experiences in the business world, we both know that the success of any operation depends far less on the tools and facilities provided than on the people who run it. You have said that as programs change at the national labs, so the funding must change as well. I want to take issue with this. The reason why Argonne and the other labs are as great as they are is the tremendously talented group of people they have assembled. We surely cannot change a nuclear engineer into a genetic scientist overnight. But I think there is a great deal of flexibility within the labs. These are, by and large, versatile people with broad scientific skills. Consequently, when we cut programs and then slash funding, it is not like we are eliminating outmoded and overspecialized machinery—we are depriving our labs of talented people who are capable of performing a variety of valuable research.

Later on, when we recognize our need for these people, they would be gone. These labs would take years to rebuild. Eliminating personnel threatens the "critical mass" of intelligence capability we have created in our labs. Will you fully consider this as well as the merits of individual programs when funding decisions are made? Could you work together with me in fully considering this aspect, not just in, "Do we need this program or that", but also, "Do we need the continuity that would enable us to keep this?" And, in looking at individual programs, consider the funding decisions based on what it would really cost us if we lost personnel and had to bring them back 6 months or a year from now when we've started on a new phase of the program and economic recovery is back up, we hope.

Mr. BALDRIGE. Yes, Senator, I will. I recognize the importance of that, and I also understand the continuity of personnel. It is when we have a distinct programatic change that the problem arises. But it should be addressed as that kind of a problem, and we should work together to see how we can overcome it. I could not sit here, in all conscience, and say that we should continue programs that have a much lesser priority when there are more important ones because of changed times. But there is a real need to keep a good organization together if it is at all possible, and I'd be happy to work with you on that.

Senator PERCY. My last question pertains to the pledge that Secretary Edwards gave to me last December, that Midwest labs will receive their fair share of funding for R&D. While it's true that the overall budgets for the three Midwest energy department labs is down less than 1 percent from the 1982 level, this figure does not tell the true story so far as Argonne Laboratory is concerned. An analysis of its operating budget indicates that it was dropped from $190.9 million in fiscal year 1982 to $154 million in fiscal year 1983. That's a drop of $36.8 million, or almost 20 percent. It's serious because the work force is paid out of the operating budget. The Ames Laboratory, too, was cut 2 percent. While I'm pleased with the 21-percent increase for Fermi Lab, I'm also concerned about the future of Argonne with this sort of crippling reduction, which could do a tremendous amount of harm to this vital institution. How might we work together to make certain that the critical mass that Argonne can remain and can be available as one of our great national resources in terms of R&D?

Mr. BALDRIGE. Well, Senator, I think everyone here knows that Argonne is taking a 17-percent cut. While I don't want to pretend that this cut will be easy, many branches of the U.S. Government are taking that large a cut and many are taking a larger cut. I'm the head of a Department that will have taken a 25-percent cut in administrative personel by the end of this year. Argonne's cut will be tough, there's no two ways about that. The reason has nothing to do with the excellence of the lab. It's because over half of the budget at Argonne is in energy R&D—a program that is being cut by about one-third. I think this couples with your last question.

We do, I think, have some differences on what kind of energy conservation demonstration projects are really necessary with the price of fuel this high. I have not got into the details because it's really not my purview until the Senate, in its wisdom, and the House, in its wisdom, either decides to transfer the Department of Energy to the

Department of Commerce, or not. But I think, regardless of how we end up, there clearly is a lot of the conservation part of this that can be done by the private sector, and is being done by the private sector.

Once I've said that, I can also say that when you have a fine organization, you can't turn it off and on like an alarm clock—I understand that as well as anybody in this room does. While I could sit here and make promises today, I do not have the authority to do so. However, I would be very willing to talk about these issues as they come up.

Senator PERCY. Thank you very much. And, to our guest today, I would like to say that I've worked with every Secretary of Commerce since 1952, in the first Eisenhower year—including Pete Peterson, my valued successor at Bell & Howell, and had a tremendous lot of fun working with him. But I've never really enjoyed working more and had greater confidence in a Secretary of Commerce than in Mr. Baldrige.

I was asked what my pin says, and it says "We dig coal." I'd just like you to remember that, and my tie says, "Chicago is Great!" We just want you to think, as you fly back on the plane today, that Chicago has, and the Chicago area and Illinois and the Midwest, has tremendous facilities available to accomplish and keep, not just Chicago great, but America great. We have really enjoyed having you with us, and we're privileged to have had you take the trip out for this purpose.

Mr. BALDRIGE. Well, Senator, you're a great digger for your State, I'll tell you that. [Laughter and applause.]

Senator PERCY. Our next witness is our own Gov. Jim Thompson. [Applause.]

I am honored to introduce, to this distinguished audience, someone who needs no introduction, obviously. I do not know of any governor in the United States of America as committed and dedicated to bringing new industry to his State as Jim Thompson has been. It seems he spends every waking moment trying to find new ways to bring jobs to Illinois. I understand that his advisory board on high technology will report its findings this Wednesday. I am very much looking forward to hearing its recommendations, and pledge to do everything I can to help implement that program and a similar plan which, I understand, has been put together by Mayor Byrne.

Governor Thompson, we very much appreciate your being with us today.

TESTIMONY OF JAMES R. THOMPSON, GOVERNOR OF THE STATE OF ILLINOIS

Mr. THOMPSON. Mr. Chairman, thank you.

I appreciate, very much, your willingness to bring the processes of the Federal Government, and, most particularly, the processes of the legislative branch in terms of oversight to this facility. I think that, far too often, people, whether in examining the role of local, State, or Federal Government, sometimes feel a sense of estrangement from the process and how it actually functions. I think it critical, therefore, as the national administration debates the future of Argonne and Fermi Lab and the other associated Midwestern national laboratories, that, not only do the people of Argonne, the dedicated staff, but the people of this area, the people of Illinois, get to see, firsthand, through the processes of your subcommittee hearing, how you feel and how your colleagues feel about the future of this and the other facilities. And, there is no substitute for bringing the Congress back home to your State in demonstrating how well it functions in this regard. I thank you for bringing this hearing to Argonne, and for bringing our Federal Government back home to us in this fashion; I think it important.

Unlike some areas in the country that are now aggressively pursuing the establishment of high-technology centers, I think it should be emphasized that the Chicago metropolitan area is already a research and development center. As you know and made reference to in the dedication of the scrubber facility this morning, Mr. Chairman, Enrico Fermi, working at the University of Chicago, carried out the first controlled nuclear chain reaction. Since that time, research in the Chicago metropolitan area has prospered, with our fine universities continuing, producing scientists and carrying out research, and, in the private sector, many of the Nation's leading corporations deeply engaged in R&D programs.

Given this history in Illinois, I believe we do not need to create a new high-technology center from the ground up. I emphasize the words, from the ground up, because they are the important ones in that sentence. A significant high-technology center, fostered around Argonne, Fermi Lab and our universities and corporations, already exists. What we need to do is to maintain present research efforts from the center to find new methods of promoting further expansion. The report of the Governor's high-tech task force, which will be delivered to me in just 2 days, goes quite far in that regard. It is available for your perusal, Senator, even though it is not yet officially released.

In order to foster this kind of high-technology development in Illinois—it is of fundamental importance that Argonne and Fermi Lab continue to conduct and expand their research efforts. The level of operations at these facilities must not be cut back if high technology and research and development are to expand in Illinois, in and out of the private sector. The reasons for this are clear. The importance of interaction and the exchange of information between members of the scientific community and our Federal laboratories is paramount to the growth and development of any scientific community. The importance of that relationship is no exception in the Chicagoland area.

For example, it has been noted, Dr. Massey, the director of this facility, serves as the chairman of the Mayor of the City of Chicago's High-Tech Task Force. Serving as cochairmen of the Governor's High-Tech Task Force, Mr. William Ylvisaker of Gould Corp., from the private sector, and President Stanley Ikenberry, from the educational sector. The inter-relationship of the two task forces, though they serve two levels of government, is already established.

The exchange of ideas and talent among scientists, the business community, university personnel and governmental officials is essential, because it is at the heart of economic development and enlightened leadership. Here in Illinois, for instance, there is a significant transfer of knowledge and talent in the R&D field among the national laboratories, the universities, and companies such as Amoco, Gould, Bell Telephone, Motorola, International Harvester, and Northrup.

During its years of existence, the Argonne National Laboratory has made a tremendous contribution to the State and to the Nation, especially in the areas of energy, environment, and transportation. Because Argonne is a regional facility, it has been particularly essential to issues of regional concern. And, I want to emphasize that I speak, not only for the State of Illinois in hoping that you will be instrumental in persuading the national administration—and I hope we will be, as well—in not cutting back on Fermi Lab and Argonne, because, it's important to the region; it's important to our neighboring States. There is a sameness in the Midwest, and what is learned at Argonne that's of use to Illinois is probably of use to Wisconsin and our neighbors as well.

In Illinois, Argonne has worked with the State Geological Survey to analyze radioactive substances found in water wells, it has assisted the Department of Mines and Minerals in mine-land reclamation, and has worked with the Department of Natural Resources on a host of energy and natural resource issues. They range from studies on the impacts of acid rain on agriculture to preparing a State energy plan. Argonne has provided its expertise in these areas and many more for the benefit of more than 24 State agencies. There are 24 separate State agencies that have an inter-relationship with Argonne and its personnel. Thirty-one local agencies of government and 22 educational institutions.

This is particularly important, I believe, in the area of coal R&D, not only in terms of our national security—because increasing independence from foreign-sourced oil is essential to our national security—but to our economic expansion here in the United States; particularly in the Midwest and particularly in Illinois. I know that this is a goal of the President, because the Republican Governors of the Nation helped candidate Reagan draft his coal plan when he was a candidate for the Presidency. The President paid particular attention, I believe, to the economic future of this Nation and the national security future of this Nation by increasing reliance on coal.

Argonne and its personnel have been involved with the three, now major, R&D developments in the State of Illinois in the future use of Illinois coal: The fluidized bed process now undergoing tests at Great Lakes, the kilm gas project, undergoing tests at Wood River, and the recently announced conversion by dry scrubber technology that we saw this morning, Senator, at the Abbott Power Plant at the University of Illinois. And, in fact, a member of my own cabinet, Dr. Philip Gustaphson, who directs the Department of Nuclear Safety, a new department in the State of Illinois, is serving me and the citizens of the State of Illinois while he is on leave of absence from Argonne; another example of this transfer facility of a national laboratory.

In addition to the expertise provided by our national laboratories, however, there is one other question that I think must be addressed here, concerning the distribution of Federal funds for research and development, and that is the question of equity. I note that the Secretary of Commerce, in his testimony, stressed that it was an executive branch decision in terms of changing priorities within the R&D field, and I acknowledge that and I think the Congress would as well. But there must be, inserted into the process, the question of equity. As we all know, the bulk of Federal money spent for research and development goes to defense-related projects; most of which are developed in regions such as the East, the South, and the West. The Midwest, historically, has been at a disadvantage in receiving these defense-contract dollars. For that reason, I think it is additionally important for the Federal Government to renew and maintain its commitment to Midwest civilian research laboratories.

I know our congressional delegation has been especially active, together with our State administration, in the pursuit of additional defense dollars for the State of Illinois, to redress historical imbalances that have gone on for far too long. This is another area where the congressional delegation, where the whole Congress can help redress that imbalance.

On the other hand, expanding the Federal defense budget while cutting back on civilian R&D will only exacerbate the imbalance that already exists between the regions of this country in Federal dollars received, and, inevitably, the Midwest will be the loser. This imbalance must not be perpetuated. My concern is not with traditional pork-barrel projects.

My concern is with the necessity for equity in the distribution of Federal funds, and for the continuation of important national research at an already established national laboratory. Moreover, the kinds of research and the discoveries that continue to be made by scientists at our civilian research and development centers play a vital role in providing for our national security in ways other than simply producing military hardware.

As Governor of the fifth-largest State in the country, I think that, not only must the Federal Government continue its commitment to the role Argonne National Laboratory has played in our national research and development growth, but it must also renew its commitment to the equity of these important research dollars important to our national economy and our national security.

I am committed to the continuation of a strong research and development program in the State of Illinois. Each sector, private and public, certainly has a role. But, if we are to advance from our present high state as a high-technology center in this State, it is imperative that the Federal Government maintain a strong research program at its facilities in Illinois, and I will work with you to see that that is achieved. Thank you very much. [Applause].

Senator PERCY. Thank you, Governor Thompson.

Audience response is prohibited in hearings in Washington, D.C.; is expressly encouraged in audiences in Illinois. [Laughter] That's the difference between Washington and having them out here in our own State. We can set our own rules.

Mr. THOMPSON. Exactly right.

Senator PERCY. Governor Thompson, we have a problem of moving from the State that has produced heavily in farm products and consumer goods to seeing if we can leapfrog into high technology, and we are in competition, you're in competition with every other Governor, particularly in California and the Sun Belt States, I am with every other senator, and, Congressman John Erlenborn—who, by the way, could not be here today because of a bad case of bronchitis—but he has been in the forefront of fighting with us in our congressional delegation. But, I wonder if you could tell us, because you do know this and are aware of how competitive we are, whether you agree with me that Argonne and Fermi play a vital role in helping to attract the very kind of high-technology industries that we want to bring to Illinois?

Mr. THOMPSON. Senator, I can, and I will use the words of the yet-to-be released report of the Governor's high-tech force. It will come out on Wednesday, but I will read just one paragraph to you from page 2.

> The task force recommends, therefore, that the state of Illinois nurture the development of high-technology complexes near universities, the Argonne Laboratory, Fermi National Accelerator Laboratory, and other sites which possess special technical strengths. Illinois should encourage location of high-technology industry in these areas. A key aspect of such sites should be research and development activities involving both academic and industrial scientists.

And, Senator, the report of this task force calls for the commitment of more than $30 million, over the next 3 years, in State funds, for the establishment of these high-technology centers, keyed off of existing high-tech centers like Argonne and Fermi National Labs. And, I'll point out something else that I think is important too. I agree that, what we need to be doing in Illinois, what we are doing right now and have been doing through the course of this administration, is not moving away from the basic strength of this State in heavy machinery, heavy metals, agriculture and agribusiness; but supplementing those great strengths. Filling in the cracks in our economy with high-tech, with light manufacturing, with service industries, in an effort to recession-proof the economy of this State. Other States began long before we did.

For example, the Research Triangle Park in North Carolina, which is often talked about, began 20 years ago. Silicon Valley, in California, grew during the early 1970's. Route 128, near Boston's great universities, has been coming along. Now, we're not trying to play catch up. It is important to emphasize that, Chicago and Illinois has long been a high-technology center. We can, and are doing much more. If we are to invest State resources directly in high-technology centers, as the Governor's task force report will recommend on Wednesday, or indirectly, through the beefing up the resources of our great universities. We have the finest engineering school in the entire world located in Illinois. It is critical that we be able to key off existing national laboratories like Argonne and Fermilab. Otherwise, we don't have a chance of catching or surpassing the other States, which began their efforts 20 years ago.

Senator PERCY. The last question I have for you, Governor Thompson, is just, you have been in Washington to fight for fair funding for Illinois, more than any other Governor in the history of the State, and you're going to continue and you've pledged to me that you will continue.

Mr. THOMPSON. I will.

Senator PERCY. Can we, the next time I meet with the Illinois delegation, indicate that we jointly feel that we should put one of the highest priorities now, and, if necessary, meet with another native Illinoisan, President Reagan, to emphasize to him that, the "heartland of America" and the future of this whole Midwestern region lies right in our research and development. And, we've got to fight for those budgets and not let them cut those budgets which cut the heart out of our future.

Mr. THOMPSON. Yes, sir. As you note, Senator, and as you saw last year, I went to Washington to visit you, other members of the delegation, and the President and the Cabinet, 23 times. On every one of those 23 trips, substantial efforts were devoted to protecting the interests of the State of Illinois. Now, I told the President last year, that I, along with 49 other Governors, believed that we had to reach the bottom line of his budget in order to help bring an end to the staggering deficits that this Nation faces, which, in turn would impact on interest rates and very vital sectors of our economy: steel, auto, retail, agriculture, housing, all of which are important to Illinois. We felt free to attempt to influence the middle lines of his budget to protect our State—that was my job as the Governor.

This year, I have told the President, based on his 1983 proposed budget to the Congress, I will be forced to disagree with some of the bottom lines of his budget in key areas involving our national security and the economic health of my State. And, he understands this, and he understands that I must, even as a member of his party, make this effort for my State; and I will.

I believe that the national security of the United States is as much involved by the preservation and the enhancement of national laboratories like Argonne and Fermilab as it is with the development of any weapons system, exotic or mundane, that the Pentagon has in store for us. I believe that, and I think the Congress ought to do that. [Applause.]

I will add one other thought: I am not a defense expert, and I do not lightly suggest to the President, as I have, that he considers again, the transfer of some portion of the Pentagon budget to activities like Argonne and Fermilab and economic renewal of our Nation's cities and economic uplift for our agricultural areas. That is the proper function of our Congress, through oversight and appropriations committees. You and your colleagues, Senator, have the expertise to tell me and millions of other American citizens whether I'm right or wrong in believing that. I believe I am right.

Senator PERCY. I think this audience believes you are right also. Thank you very much.

Mr. THOMPSON. Thank you. [Applause.]

Senator PERCY. Our next witness is Dr. Al Trivelpiece, Director of the Office of Energy Research at the Department of Energy. He is directly responsible for the national laboratories and energy technology training activity. Before joining Government, he was a corporate vice president of Science Applications out of La Jolla, Calif., primarily responsible for internal research programs relative to innovative technical development. He holds several patents in the area of physics research, and is the author or coauthor of over 100 technical reports and books. We're pleased to have him today representing Secretary of Energy Edwards. Dr. Trivelpiece, we look forward to your testimony.

Mr. **Trivelpiece.** Thank you, Mr. Chairman.

Senator **Percy.** Even if you're not going to look forward to my questions.

Mr. **Trivelpiece.** Oh, I look forward to your questions; I hope you look forward to my answers. [Laughter.]

I'm pleased to have the opportunity to discuss certain aspects of the R&D programs that the Department of Energy manages. And, with your permission, I would like to have my prepared statement submitted for the record, and then proceed to some remarks.

Senator **Percy.** A full copy will go into the record, and a summary would be appreciated.

TESTIMONY OF ALVIN W. TRIVELPIECE, DIRECTOR, OFFICE OF RESEARCH, DEPARTMENT OF ENERGY

Mr. **Trivelpiece.** The Department of Energy manages a total of 57 facilities, almost all of these are Government owned, contract or operated. And, of these 57, 12 of them are designated as major multiprogram laboratories. Argonne and Ames are so designated. The Fermilab so a so-called, single-purpose laboratory that is concerned with only one area of physics; namely, high energy physics. How each of these 56 facilities came into existence and what they do is quite a fascinating story, and today, you're going to hear something about three of them from the directors of those facilities.

Now, the President's budget, as it was submitted to Congress, reflects two characteristics that are of concern here today. These are: first, a clearly stated policy to support long-range, high-risk basic research and technology development in certain areas; and, an equally clearly stated policy not to support certain short-range development and commercialization projects that can be better done in the private sector.

The consequence of the application of this policy has been to cause a reduction in certain programs in most of the Department's multiprogram laboratories, and only a constant level of effort support for most other projects, in an attempt to control spending overall. Fermilab is scheduled for some slight growth, Argonne is facing a reduction, and, as you indicated, Ames Laboratory is being held at approximately constant budget.

Administering reductions of this sort is a wrenching experience on the laboratory directors, and it's a serious morale problem for the laboratories. Over the years, most of the laboratories have seen major programs come and go, and most have experienced both periods of general growth and general decline. To some extent, that's the nature of the research and development business. Most of us who have worked in it understand that this is an endemic problem. Nevertheless, there is a need to balance the requirement to remain flexible with the need to be able to change programs as the Nation's needs change, and the need to provide some measure of stability in the system so that a certain solid corps of scientific expertise is maintained and utilized effectively.

How to accomplish this is not clear, and several groups are exploring various aspects of this problem. Secretary Baldridge pointed out that the Office of Science and Technology Policy has a group examining this. Another group is the Department of Energy's Energy Research Advisory Board, which is examining the long-range, strategic role of the Department of Energy's laboratories. The results of their deliberations will be available late this year. I'm looking forward to seeing if the results of their work provide some good new ideas on how we can cope with some of our problems. And, if they have beneficial insights, we will take those into account in our own activities.

In spite of the current budget stringencies that we're forced to deal with, there's a clear need to continue to support the national laboratories and universities in various key areas of science and technology. The nation has benefited greatly from its investment in these institutions and programs. The high-energy physics programs of the early 1930's, which led to the Atomic Energy Commission, are watershed events that have resulted in entire industries coming into existence, such as the nuclear power industry. Argonne Laboratory has played an important role in this activity.

These activities have also brought into existence the use of nuclear tools in medicine, both diagnostic and for therapy. There's a 1 in 2 chance that, upon entering a hospital, you are going to benefit from some nuclear medicine application, either for diagnostics or for therapy. This amounts to a multimillion dollar industry in the United States. The payback in taxes alone probably justifies this investment, not even taking into account the benefits to human life.

I'd like to summarize and state that I believe that the national laboratories, universities and industry each have a role to play in our Nation's science and technology enterprise. Each is experiencing some difficulties in the present economic climate. In spite of these difficulties, I hope that we can maintain a solid corps of scientific expertise at our universities and national laboratories.

The world in which we live is becoming progressively more technically complicated, and our ability to compete in that world as a nation and an international marketplace is going to depend on how well we do in the complex, high-technology arenas. I can't imagine succeeding at this endeavor without strong national laboratories and strong universities, working together with industry

Mr. Chairman, that completes my remarks. Thank you.

Senator **Percy**. Thank you very much indeed, Doctor. And I appreciate the letter from Dr. Edwards—if you would tell him that for me.

I am disturbed to have learned, last week, that under the fiscal year 1983 budget for the Department of Energy, you proposed an additional 20-percent cut in Argonne budget on top of the very severe reduction of this year. Because you are appearing here, as a representative of Secretary Edwards, I'd like to just give you his exact words that he gave to me before a meeting of this subcommittee in December about the future of Argonne. He said, "I have no plans, whatsoever, to close down any of the laboratories." That is, the laboratories I was talking about—Fermi, Ames, and Argonne.

At that time, I received his personal assurance that he had not heard of any attempt to cripple any of the Argonne programs. A 20-percent reduction, if approved by Congress, would have a devastating effect on Argonne. It would just be like saying, "The patient is doing very well, except we had to amputate his arm and leg." Scientists really tend to plan their entire careers, as you know, working around a particular lab like Argonne, Fermi, and Ames. They don't move around, like officials in Washington, from agency to agency and job to job. I personally believe that Secretary Edwards is a man of his word, and I took him at his word. [Applause.] I wonder if you'd be good enough to convey to him and to the administration my belief that any further cuts at Argonne of the magnitudes proposed could indeed cripple the facility by robbing it of its best and brightest staff. And it's those that are sometimes the best and the brightest, that when there's uncertainty and a lack of morale, the morale does go down, and they just tend to look around. Could you convey to him, in the strongest possible terms, since he could not be here today, the commitment that he did give to me last December, and tell him that I'd like to discuss that further with him.

Mr. **Trivelpiece**. I will convey your concerns to the Secretary.

Senator **Percy**. You are a scientist yourself, and I think you know how scientists look upon their careers with institutions like Argonne National Laboratories, Ames, and Fermi. In many cases, they see themselves making a lifetime commitment to the work that they are doing. When major changes and priorities happen overnight, and especially when those changes are accompanied by big budget cuts, this can really have a devastating effect. And we're talking about more than just the livelihood of a few people, we're talking about the lifeblood of the research community and what will keep America economically and militarily strong for decades ahead. My question is: Do you, and others, at DOE and OMB, as scientists, truly understand both the short-range and the long-range effects that these budget cuts could have at Argonne and other Midwestern institutions?

Mr. **Trivelpiece**. Yes, sir; I believe I am both personally and institutionally aware of the consequences of these budgets. But, as I indicated in my remarks, research programs do change, projects do finish, emphasis and attitudes do change, and there is not any particular institutional bias against Argonne in this concern. Programs that have started at Argonne were reduced in their scope and magnitude, and that has had an impact on it. I am not unmindful of the personal dislocation that causes to people; and we're certainly trying, as best we can under these circumstances, to administer the cuts in a fair and equitable manner to see to it that no institution suffers unnecessarily or unduly.

Senator **Percy**. What do you think, as a scientist, that the consequences would actually be if we scale back our personnel? If we cut these programs, programs that have been considered to be eminently worthwhile; the very kind of program that we dedicated this morning. Where, considering the modest amount of investment that was made, the payoff is going to be absolutely huge, not only for national security, but balance of payments, employment, and everything else. And yet, we've got laws that say, "You cannot use high-sulfur coal unless you are able to scrub it." And now, we're going to have a technology that is a dramatic breakthrough, the same kind of dramatic breakthrough that you mentioned in the opening comments of your statement, where we say we have a whole new era of science and technical advances. But, what kind of consequences will follow if we just cut the heart out of these programs?

Mr. **Trivelpiece**. Administering scientific programs, even during periods of budget growth, is difficult, because the collection of individuals that make their livelihood in this activity can see many more things to do than there is ever likely to be resources with which to do them. During periods of reduction, such as we're currently facing, it becomes even more difficult. You see activities which you sincerely believe should be continued and believe are important to the Nation's future, and yet it is a question of providing the resources within an overall restrained budget. I don't have any better ability to do that than anyone else. It is a compromise between things of different priorities and different arenas, and trying to adjust within those arenas and those priorities.

Senator PERCY. Being a scientist and a prominent member of the private sector, I don't have to remind you that witnesses before senatorial committees are asked not only to speak on behalf of the administration, but many times are asked to speak their own minds; what they personally do believe. I'd like to take that prerogative now and just say, you don't have to enunciate the administration's policies. What do you think should be the right policy, when we have a $126 billion buildup in the defense budget, and yet, we're taking and cutting programs out that involve millions, that may involve future billions of income for this economy? How can you have a strong defense if you don't have a strong economy under it? And this is the kind of expenditure even John Tower is now talking about taking billions out. I think we can take $10 billion out of that defense budget and put it back to work in other areas, or reduce the budget and get down the high interest costs and strengthen America much more. [Applause.] I'm certainly glad this hearing's not being held in Washington. [Laughter.] I'd have to gavel you all quiet.

Could you give us your personal opinion on how you'd put priorities? Don't you think a few billion can be taken away from a program that's being increased $126 billion and put to work right here and make America overall stronger than if we just bought more hardware; hopefully, every bit of it, in the strategic field that will never be used.

Mr. TRIVELPIECE. In an absolute sense, I certainly support a strong R&D program in the United States. I can't conceive of a situation in which the future economic health would not be served by a stronger R&D program, and there are certain appropriate Federal roles for R&D. Where the resources are to come from and whether or not they should come from current planned growth in the Department of Defense or some other area of Government, I don't really believe it is my position to say at the moment.

Senator PERCY. I'd like to put the same question to you as I did to Secretary Baldrige on energy conservation. As you know, the hardest heads in this country are on the board of the Alliance to Save Energy. Major oil company executives—people like Fred Hartley and John Swearingen—have helped us both out as chairmen of the American Petroleum Institute and former Deputy Secretary of Defense, David Packard. They cannot conceive that a better investment could be made than in energy conservation; making us more energy efficient. That is the best way to create a new source of energy. They feel so strongly about it that, this past year, Fred Hartley has collected $300,000 out of a million dollar budget from oil companies, to convince America, through our advertising counsel budgets and Gregory Peck editorials and so forth on television and radio, to use less energy and use it more efficiently.

Now, what we can't do with a million dollar budget, is to do all of that to change the attitudes of 220-million people, is do the research and development also that will help us develop new energy techniques that can then be promoted and advertised by us. How do you feel about slashing conservation budgets 97 percent. Do you think we've reached the ultimate already in conservation? That there's no more energy to be created in this sensible approach to finding new energy through conservation?

Mr. TRIVELPIECE. Conservation doesn't create new energy, it only keeps what we have from being used more rapidly.

Senator PERCY. That's news as far as I'm concerned, because otherwise, it's just wasted.

Mr. TRIVELPIECE. It doesn't create new energy, it just makes energy that already exists more effective and more efficient.

Senator PERCY. I'm going to correct you on that. You're absolutely wrong. If you got a tank of 1,000 gallons of oil out here, you pump it into an inefficient building and it's used up within a week, and you insulate this building and have it out there 3 weeks instead of 1 week, you've created 750 barrels of oil, of energy. You've created new energy in every sense of the word; in any practical sense.

Well, I hope for a different point of view on the floor of the Congress, which has the power and the authority and the responsibility to set spending priorities by the Constitution, and that's what we intend to do.

Let's talk about coal. I believe it's a national goal, without any equivocation or question, by the last three Presidents in a row now, that we develop coal and rely more on coal and on imported oil, particularly, for our security and for our economy. And, a part of that is the full development of the high-sulfur, Illinois-basin coal industry, which is vital to the Nation now. It can create additional employment, it can aid economically distressed areas, particularly in the Midwest, and help earn valuable foreign exchange through exports for our Government. I just don't understand why a whole variety of programs designed to remove sulfur from the coal at an affordable cost is being eliminated at Argonne. It just doesn't make any economic sense at all. I'd fire, as the director of a company, the chief executives that set their priorities that way. I can't understand why these would include the wet scrubber program, the atmospheric fluidized beds and a variety of environmental programs.

Another area of interest for both the farm and coal communities is the land reclamation program. Several of the largest coal producers in the United States have invested considerable money and effort in developing research and facilities at mine sites for the reclamation program. The program at Argonne is being phased out. Why are these cuts being made, and how can we really defend such cuts?

Mr. TRIVELPIECE. I can't speak to the high-sulfur coal activities—those are the responsibility of another assistant secretary—and the decisionmaking that went into coming to the final conclusions are not known to me. The land reclamation program is one that is being managed by one of the directors that reports to me. I don't have a good answer to your question at the moment—I'd be glad to supply one for the record.

[The information referred to follows:]

The land reclamation program was implemented in fiscal year 1975, shortly after the Energy Research and Development Administration was created and before the Office of Surface Mining was established. Our purpose in implementing this program was to deal with certain environmental issues such as mining of alluvial valley floors and prime agricultural farmland, reclamation of surface mines in arid regions and reestablishment of hydrological balance in mined areas. These issues presented possible constraints to increased utilization of our coal resources. It should be recognized that during this period the DOE was not the only place where mining reclamation research was carried out. Other agencies, as well as private industry and universities, were also conducting research and experimenting with reclamation technologies. Subsequently, the Surface Mining Control and Reclamation Act was passed which established the Office of Surface Mining to regulate mined land reclamation. This act also established standards and clarified industry's responsibilities for reclaiming mined areas.

In its review of the fiscal year 1982 budget, the administration concluded that land reclamation research related to coal mining should no longer be the responsibility of the Department of Energy (DOE). It was also concluded that industry must now assume a greater responsibility for land reclamation research. Consequently, no funds were provided in the DOE/OHER budget for land reclamation research. In order to avoid sudden termination of the research activities at the Argonne National Laboratory (ANL), funding has been provided in fiscal year 1982 to phase out DOE support for research activities and allow orderly completion of the research. The Administration encourages and will assist the Laboratory in seeking funding from other sources for R&D activities that could be pursued.

Senator PERCY. I think this might be the last or the next-to-the-last question. Dr. Trivelpiece, I happen to believe that coal R&D is, as you can tell, very important to the Nation and to our future. We simply must lessen our dependence on oil, which comes to us from a very unstable part of the world. We've seen previous embargos cripple industry, education, hospitals and defense if it were cut off.

Another reason I bring up coal R&D—I could bring up conservation, alcohol fuels, or solar energy just as easily—is that this is the kind of research that would really keep jobs here in the Middle West—the part of the country most hard hit by the decline in home construction, automobile industries and steel industries. And, we have the highest, Michigan having the highest unemployment rate in the United States, Illinois fourth, and so forth. As a Californian who recently came to Washington from the San Diego area, an area that would benefit enormously from the new defense-oriented priorities that the administration is proposing, I think it is good that you can learn firsthand, and we deeply appreciate your coming out personally to another part of the United States that stands to really lose jobs if these budget proposals are adopted. This is why I am urging so insistently that our R&D activities, especially in the energy field, have to be diversified throughout the United States. This is why I'm such a strong supporter of the Argonne National Laboratory in the face of these proposed budget cuts. Do you have any response to this from the standpoint of the geography of the situation, and, taking into account the law that provides that we must take into account depressed areas of the United States of America that have been extremely hard hit. I could take you to Kankakee, I could take you to Galesburg, where unemployment levels are running 17 and 18 percent and getting higher. Do you agree with me that the administration cannot really blind itself to the effects these budget cuts may have on a Midwestern State like Illinois, as well as an effect on the Nation?

Mr. **Trivelpiece.** The budget cuts, or proposed cuts, were not assigned to laboratories on an institutional or geographic basis. They are a consequence of programmatic decisions that were made by individual managers within the Department who have responsibility for various programs. The effect is, nevertheless, the same as if it had been institutional. We don't have a basis for providing support on an institutional. We don't have a basis for providing support on an institutional basis. It is, literally, the sum of all the programs that make up a given laboratory's collection of activities, and these come from various assistant secretaries and directors of the various programs. I share your concern. I don't have the machinery with which to address it on an institutional basis. We are very concerned, and I have some oversight responsibility within the Department for some of the multiprogram laboratories. We do concern ourselves about their institutional health, but there is not a separate basis for addressing that from a fiscal point of view.

Senator **Percy.** I will call Secretary Edwards when I return to Washington, to thank him for your appearance. You will, probably, see him before I get that call to him. If you would tell him, remind him once again, of what I said to him and to Secretary Baldrige when they called on me to see what my attitude would be about the reorganization plan that's up for this committee for decision. That, it'll be conditioned, my judgment will be conditioned upon the sense of priorities and the sense of thrust that we see now that the administration's been in office for over a year. Where are we going? What kind of a program are we going to be carrying out? I can see no objective being served, usefully, in dismantling an organization to reconstruct it if what we reconstruct is going to be even worse than what we had—without a sense of priorities. So, my judgment will be very much dependent upon the sense of priorities that we have, and some of the answers to the questions that I think that I've put here, which I think will be backed up and supported by literally every Senator and Congressman that comes from this center of the country. I thank you very much for being with us.

Mr. **Trivelpiece.** Thank you, Senator. [Applause.]

[Mr. Trivelpiece's prepared statement follows:]

Statement of Alvin W. Trivelpiece
Director
Office of Energy Research
Department of Energy
Hearing before
Senate Governmental Affairs
Subcommittee on Energy, Nuclear Proliferation
and Government Processes
March 22, 1982
Argonne National Laboratory
Argonne, Illinois

Mr. Chairman:

Thank you for the opportunity to address you this morning. Initially, I would like to give you some background on the traditional role Government has played in support of scientific research from the days of the Atomic Energy Commission (AEC), the Energy Research and Development Administration (ERDA) and, currently, the Department of Energy (DOE). Then, I plan to discuss the Department's view of the roles of the Ames Laboratory, the Argonne National Laboratory (ANL), and the Fermi National Accelerator Laboratory (Fermilab) and to mention some of the significant accomplishments of these important national resources.

In some respects, the AEC-ERDA-DOE science tradition predates even the Atomic Energy Commission. Lawrence Berkeley Laboratory dates back to 1931. Argonne was created in 1946 and Ames in 1947. Only Fermilab is a relative newcomer in the Midwest having been constructed in the late 1960's. Let me remind you of the post-war situation in which the AEC was formed. The world had seen the scientific progress of the 30's, with the first mapping of the properties of the atomic nucleus, leading to a remarkable scientific achievement that took place in Chicago on December 2, 1942 - when the world's first successful chain reaction (Chicago Pile-1) was achieved under the West Stands of Stagg Field at the University of Chicago. It was clear that we were entering a new era in science and technology.

The development of nuclear energy had its roots in the work of a handful of path-breaking scientists. Many of them were emigrees whose traditions were in academic research. After the war, many of them returned to academic life. However, some of them retained their ties with the Atomic Energy Commission laboratories, which had major facilities that were not available on campus. As a result, and as the national laboratories evolved, there arose a symbiosis with with the nation's universities. The AEC supported research in many universities. Many of the laboratories came to be managed by universities or university consortia.

Today a central purpose of many of the DOE laboratories is to provide facilities for university users (e.g., Fermilab). Some laboratories are located at universities (e.g., Ames Laboratory). Over the years, the programs at our DOE laboratories have evolved as an integral part of the mainstream of modern science, by providing a "research home" for thousands of university scientists in disciplines that span the physical and biological sciences. The laboratories provided facilities and a multidisciplinary research environment that even the largest universities could not duplicate. In turn, the universities provided a stream of talented young people that helped maintain the intellectual vitality of the laboratory system. This symbiosis has been enormously productive. In the course of exploring nature, the programs that were initiated by the AEC have led to a plethora of practical and useful civilian benefits. Some of the most significant to the Nation include: (1) at Argonne National Laboratory, the boiling-water reactor was conceived and designed and is the prototype of many of today's commercial nuclear power plants which provide electricity to the nation's grid; and (2) essentially all of the metallic uranium that has been utilized in the western world has been prepared using the process developed at Ames.

Today the DOE research programs, many of which evolved from these AEC beginnings, have seen many changes: reorganizations, budget fluctuations, and recessions. They have also experienced one very important continuity: the continued appreciation by successive Administrations and Congresses that a vigorous commitment to science is a federal responsibility. The current Administration recognizes that the benefits of future intellectual breakthroughs will not be available unless the Nation continues to invest in new research. We can never project future budgets with complete confidence. However, this Administration has indicated a firm and continued commitment to support scientific research even in these difficult economic times. I believe the present Congress also understands the value of science and its importance for the future.

The United States commitment to R&D has changed in several ways: (1) the Federal Government is no longer attempting to be responsible for all approaches to energy development; and (2) the Administration is emphasizing commitment to a strong Federal role in long-term energy research in the national interest which the private sector is not able to support sufficiently. The Department's proposed FY 1983 budget of $2.5 B in the General Science and Research and Energy Supply Research and Development accounts reflects continued support for this long-term research in the general and basic energy sciences.

The laboratories, universities and industry are vital in carrying out the Administration's policy of supporting research on long-term, high risk technologies with potentially high pay-offs. For example, it is the role of the Ames Laboratory to conduct basic research aimed improving our understanding of the physical, chemical, and materials sciences which underlie energy and other technologies essential to national interests. Ames Laboratory conducts basic research required to support the development and characterization of materials which are strong and corrosion resistant at high temperatures. Such materials are needed for any technology based on conversion of heat to electricity, and the need for high temperature materials conversion devices will persist well into the future. Proposed funding for Ames Laboratory for FY 1983 is expected to exceed $14M.

The role of the Argonne National Laboratory is to provide advanced nuclear technology research and development support to the Breeder Reactor and other fission reactor programs. Equally important, they also maintain a substantial, diversified capability in physical and biological sciences in support of the Department's efforts. Proposed funding for ANL in FY 1983 is expected to exceed $180M.

The role of Fermilab is to explore the basic structure of matter. During the last ten years, a dramatic conceptual clarification has developed with the emergence of quarks, leptons, gluons, and bosons in contemporary high energy theory. This endeavor involved experiments at Fermilab, one of the major world centers for research in high energy or particle physics. Proposed funding for Fermilab in FY 1983 is expected to be over $170M.

The role of a federal laboratory differs from the general university research role in that the laboratory conducts mission-oriented, inter-disciplinary and collaborative research. Universities tend more effectively to pursue projects that are aligned with the academic interests of single investigators, although there have emerged during the past decade a number of university associated research institutes capable of large-scale multidisciplinary research. The laboratories' roles also differ from that of most industrial research entities because the laboratory conducts open, high-risk research that is not likely to support a viable commercial enterprise before 5 to 10 years. Industrial research and development is usually directed toward proprietary projects which have high potential for commercialization within five years or less.

This is not to imply that close relationships between the laboratories and industry are not important; far from it. DOE, in fact, encourages those critical relationships as a matter of policy. Nowhere is this more true than in the area of technology transfer. Let me mention just a few laboratory accomplishments in this area. Ames developed an inductively coupled plasma atomic-emission spectroscopy method for multi-element analysis. Commercial instruments based on Ames' development have only recently been introduced. U.S. and foreign companies are already marketing these instruments. The basic science for sampling, isolating and quantifying the trace organic compounds in water was also developed at Ames. The isolation techniques have increased detection power approximately 10,000 fold for most compounds of environmental interest. The methodology has been adopted nationally and internationally by government, university and industrial laboratories.

At Argonne National Laboratory, liposome encapsulation has been applied to cancer chemotherapy. Eleven companies are using the techniques to improve efficiency and targeting of anti-cancer agents while reducing toxic side effects. Also, Argonne pioneered the technology of the Liquid Metal Cooled Fast Breeder Reactor (LMFBR) and provides component and materials testing and evaluation for the program. ANL has accumulated 16 years of LMFBR research experience that has produced the following advances: (1) the design of the first successful breeder reactor (EBR I), which produced the first usable amounts of nuclear-generated electricity; (2) the development of fast reactor and high temperature reactor fuel materials; and (3) development of the world's first transient reactor test facility (TREAT) to study fuel behavior during sudden power surges.

Even Fermilab which is dedicated to the pursuit of fundamental knowledge has a program, Fermilab Industrial Affiliates, which consists of companies that have expressed an interest in learning about the research and development underway at the laboratory. Last May, Senator Percy spoke at the first annual meeting of the group which was attended by more than 40 interested companies. Among Fermilab's accomplishments in this area was development of the world's largest standarized control system. This powerful advancement helped spawn several small new companies in the field. One is Kinetic Systems, Inc. Such control systems are now used routinely by such industrial giants as General Motors and Westinghouse. Fermilab's work in cryogenics has also had a considerable impact on the country's industrial capability in this fast advancing field. The laboratory required expansion engines, screw compressors, turbo molecular vacuum pumps and cryogenic controls and instrumentation as part of its new superconducting accelerator, now being constructed. The new Central Helium Liquifaction Facility on site doubles the world's capacity to produce liquid helium. By working hand-in-hand with Fermilab, industry has gained appreciable knowledge in the field of cryogenics.

All of the Federal laboratories were originally established to meet the mission needs of their sponsoring agencies. In the case of the Department of Energy, the missions of the Department have changed significantly over time and the private sector has greatly increased its research capabilities. The challenge before us now is, not simply to allocate Federal R&D funds more effectively, but to improve the relationships of laboratories, universities, and industry. In this way we will help to ensure the establishment of the optimium national capability in science and technology for the future. Laboratories, universities, and industry in the Midwest will benefit from this accomplishment.

As Secretary Edwards stated in his letter to Senator Percy, he is concerned with "maintaining a strong and viable R&D laboratory resource as necessary to our economic, scientific and national security position." As changes take place over the next several months, we at DOE will continue to support the Nation's core science capabilities in the laboratories. We view cooperation and collaboration among universities, national laboratories, and industry as being a key element in an effective national energy research and development program.

Senator **Percy**. I would like to insert into the record, at this time, a letter which I have written, which has been signed by a number of my colleagues, to the White House.

[The letter referred to follows:]

March 22, 1982.

Mr. Kenneth M. Duberstein,
Assistant to the President for Legislative Affairs,
The White House, Washington, D.C.

Dear Mr. Duberstein: As members of the Governmental Affairs Subcommittee on Energy, Nuclear Proliferation, and Government Processes, we would like to bring to your attention our serious concerns with the proposal to shift most of the Department of Energy functions to the Department of Commerce.

A primary goal of any reorganization should be to enable the government as a whole to operate more efficiently and smoothly for the benefit of all Americans at the least cost to the taxpayer. The proposal as currently under consideration appears to fall considerably short of this goal.

Some of us question the basic need for the dismantlement of the Department of Energy and are opposed to the transfer, while others of us are still open-minded on the reorganization of DOE functions. However, we share a number of specific concerns about the proposal as currently drafted. For instance, we feel that energy conservation and alternative and fossil fuels research and development deserve greater attention than either the proopsed fiscal year 1983 budget or proposed draft legislation reflect.

We feel there should be greater balance in the organizational structure, such as as a separate Assistant Secretary wih credible expertise who has conservation as his primary responsibility. In addition, the reorganization cannot be considered in isolation from the fiscal year 1983 budget request. We feel that the budget should reflect more balanced support for conservation, renewable, and fossil fuels.

Among other concerns is the need for a high-level official appointed by the President and confirmed by the Senate who advises the Secretary on non-proliferation matters. This person should not be charged at the same time with promoting U.S. nuclear sales or with developing nuclear technologies.

These are some, but by no means all, of our concerns about the proposed reorganization. Significant modifications in the proposal are essential. We welcome the opportunity to work with you further to assure changes reflective of our concerns.

Sincerely,

Charles H. Percy.
Dave Durenberger.
William S. Cohen.
John Glenn.
Henry M. Jackson.
Carl Levin.

Senator **Percy**. Our next witnesses will be a panel, and, I'm going to ask that this panel take into account that these hearings must adjourn at 12:30. Their full statements will be incorporated into the record. I would ask Mayor Abner Gant, president of the Dupage Mayors and Managers Association and mayor of Elmhurst to come forward, with State Representative Diana Nelson and State Senator Nimrod.

The House of Representatives has a 1-minute rule—we're going to double that this morning. I would not want this panel to be convened without having this personal opportunity to express my own deep appreciation to each one of you for all that you have meant, the fight that you've waged, and the battle that we will be carrying on together. So that, if you would be good enough to be as brief as possible, the full text of your statement will be incorporated in the record. Mayor, we'll start with you.

TESTIMONY OF ABNER S. GANET, MAYOR, ELMHURST, ILL.

Mr. GANET. Senator, the tack that I want to take this morning—and, maybe I won't even give you my full remarks—I think that what we've seen here this morning, from the people you've had from Washington, is an indication that people are not being considered. That, the effect on the budget cut at Argonne and the no-increase at Fermi has a devastating effect. And, it seems to me, that you, as our liaison with the administration in Washington have the ability to muster the forces in the legislature to see that this is not done. And, I think that, if this is an example of the people who involve, that, politically, the pressure must be put on, by people like you, to Washington, to let them know that we will not accept these cuts lying down, and I think that's the key to it.

I'm testifying today, as the mayor of the city of Elmhurst and as president of the Dupage Conference of Mayors and as an appointed spokesman of the executive committee of the Council of Mayors of 263 communities in northern Illinois. I want to thank you for calling these hearings, Senator, and I want to tell you that we have served, in Dupage County, as the host to both of these laboratories, and that, as a businessman in my own community, I realize the importance of Argonne and of Fermi in our communities. The high quality of their employees' interest and of their work on schoolboards and municipal councils in our county has really helped in all of our city. Elmhurst College, of which I am a member of their board of trustees, has had a long exchange between the faculty and Argonne staff. We were able to acquire an accelerator from Argonne, which we're using in our physics department, and which has enabled our faculty and students to augment classroom studies with a hands-on experience.

Incidentally, I would like to take this opportunity to announce that Dr. Walter Massey will be receiving an honorary Ph. D. from Elmhurst College, and he will be receiving this in June. And, we are very honored to bestow this on him.

Some of the statistics that I'd like you to understand are that Argonne's total payroll in the five counties amounted to $265 million; I'm sure you're well aware of this. As it translates, the cuts that are proposed. Downers Grove, as an example, went from 482 people employed at Argonne to 407. The same thing, a 25-percent loss in employes in the city of Joliet. The city of Elmhurst, my own community, has lost 17 percent. If these programs are cut because they're not a high priority, you could understand that. But, this is not the case. Everyone realizes that the New Federalism eliminates from the Federal Government what can be done better at local and State levels. But advanced research cannot be supported at the local level, and cutting it back is severely shortsighted in my mind.

Governor Thompson has eloquently expressed his determination to promote the development of high technology in Illinois. Senator Percy, I respectfully implore you and members of your subcommittee, along with other Members of Congress, specially members of the Illinois delegation, to vigorously support programs at our Midwest labs. On behalf of the local communities, we pledge our cooperation in your efforts, and I thank you. [Applause.]

Senator PERCY. Thank you, Mr. Mayor, very much indeed. I appreciate that.

[Mayor Ganet's prepared statement follows:]

Comments by Mayor Abner Ganet
U.S. Senatorial Subcommittee Hearing
at Argonne National Laboratory
Monday, March 22, 1982

I. Introductory Remarks

I am testifying today as mayor of the City of Elmhurst, as President of the DuPage County Council of Mayors and Managers, and as appointed spokesman for the Executive Committee of the Council of Mayors representing 263 communities in the six counties of northeastern Illinois.

On behalf of these organizations, I want to thank you, Senator, for calling this hearing here today, and for inviting the testimony from local municipalities. Too often, science and the national laboratories are considered the exclusive domain of highly specialized experts in federal and state governments, universities, in industry and in the scientific community. However, the impact of national science policy and the reason for the existence of the national laboratories is ultimately the benefit of the general public and communities like the ones I represent today.

Like citizens everywhere in the country, our local residents benefit in literally hundreds of aspects of life from the research and development conducted at the laboratories. But as host communities to the Illinois laboratories, we have a special relationship and a particular dependence on these research centers.

As a businessman in my own community, I realize the importance of laboratories such as Argonne and Fermilab locating in and among our communities. The high quality of their employees, their interest and dedication to community affairs has contributed immeasurably to the improvement of our schools, service organizations as well as our local governments. Employees of these laboratories have served on our many school boards, municipal councils and commissions as well as participated as members in many service clubs and other community-oriented organizations.

Elmhurst College has enjoyed a long and fruitful exchange between our faculty members and Argonne's staff. Some years ago, we were able to acquire a small Van de Graaff accelerator from Argonne, refurbish it and install it in our Physics Department. This has enabled our faculty and students to augment classroom studies with hands-on experience in the laboratory.

II. Some Statistics

In FY 1981, Argonne and Fermilab combined had some 6750 full-time paid employees. Though residing in more than 220 municipalities distributed across several counties, most of the employees are located in the counties of DuPage, Cook, Kane and Will.

Major concentrations of Argonne employees are in Downers Grove, Joliet, Naperville, Lockport, Lemont, Hinsdale, Bolingbrook and Woodridge while the largest employee population centers for Fermilab are Aurora, Batavia, St. Charles, West Chicago, Wheaton and Naperville.

In FY 1981, Argonne's total funding amounted to some $265,000,000 of which $138,700,000 were payroll payments. At Fermilab, about 1/3 of its FY 1981 budget, or about $40,000,000, represented payroll payments. To our communities, these two payrolls translate into a total annual economic impact of $447,500,000 -- nearly a half a billion dollars!

A breakdown of employees and payroll statistics by counties for each laboratory has been compiled and this tabulation is attached to these remarks.

Besides the influx of payroll dollars, additional economic impacts to our communities are felt by the purchase of services and products from firms located in the environs of Argonne and Fermilab.

The economic impact to communities in adjacent geographical areas to Argonne and Fermilab have been and are continuing to be important. However, the economic effects of budget constrictions can be important not only to the employees affected as well as the communities in which the RIF'd persons reside. When employees are released, payroll is lost, businesses suffer reduced purchases, bank and lending institution deposits are reduced, and service purchases become curtailed; everyone is affected.

During the past year or so, Argonne's employment has been reduced more than 600 persons. Loss of payroll alone amounted to about $18,290,000 for the year. Assuming a ripple effect of 2.5, this amounts to some $45,725,000 annually.

Many communities have been affected. Argonne employees residing in the Village of Downers Grove changed from 482 in 1980 to 407 in 1981 -- a reduction of 15.5%; during the same period 25% losses of Argonne employees took place in the City of Joliet, and the Villages of Hinsdale, Clarendon Hills and Lisle; the Villages of Woodridge and Westmont each lost 20%; City of Chicago, 17%; my own community, the City of Elmhurst, lost some 17%; many other communities have been affected too. RIF's in other communities have ranged from (5 to 15)%.

III. Concluding Remarks

If programs were being cut because they were not of a high quality, this loss would be more understandable. But the quality of work done at Argonne and Fermilab is some of the best in the world. Budgetary constrictions can affect adversely the progress of on-going research and development programs at our midwest laboratories. There is a critical need for long-term energy research in the United States.

Everyone recognizes that new federalism eliminates from Federal programs what can be done better at state and local levels. But advanced research cannot be supported at the local level. And cutting it back severely is shortsighted.

Several years ago we all remember the laisser-faire attitude by our national government to maintain our world-wide preeminence in technology developments. The launching of Sputnik galvanized our country to the hazards of this attitude. We must not let it happen again.

Our indigenous industrial base and its R&D laboratories must be encouraged to remain strong and aggressive in addressing societal needs. The colleges and universities have an important role to play in maintaining a cadre of educated citizens. However, the federal government has an equal responsibility in this scenario to maintain a viable national enterprise of economic and technological development. Our midwestern laboratories can and should be maintained as an important assembly of experts that can address high-risk long-term needs of our country, be it in energy, medical advances, or fundamental research problems.

Both Governor Thompson and Mayor Byrne have eloquently expressed their determination to promote the development of clustered high technology enterprises in Illinois. Senator Percy, I respectfully implore you and members of your subcommittee along with other members of Congress, especially members of the Illinois delegation, to vigorously support programs at our midwest laboratories. In behalf of local communities we pledge our cooperation in your efforts.

SELECTED FY 1982 STATISTICS

Argonne		Combined	Fermilab	
Payroll	Employees		Employees	Payroll
$46,401,800	1,522	DuPage (Ill.) 2126/$57,388,600	604	$10,986,800
38,411,600	1,260	Cook (Ill.) 1359/$40,212,400	99	1,800,800
nil	nil	Kane (Ill.) 1254/$22,810,400	1254	22,810,400
29,963,500	983	Will (Ill.) 1160/$33,183,100	177	3,219,600
2,191,800	72	other counties (Ill.) 109/$2,864,800	37	673,000
21,751,300	713	out of state 741/$22,260,500	28	509,200
$138,720,000	4,550	6749/$179,119,800	2199	$40,399,800

Senator PERCY. Now, two other longtime, I won't say old friends, but young friends of long standing. Senator Nimrod.

TESTIMONY OF JOHN J. NIMROD, VICE CHAIRMAN, ILLINOIS ENERGY RESOURCES COMMISSION, SPRINGFIELD, ILL.

Mr. NIMROD. Thank you, Senator Percy.

First, I want to take this opportunity to compliment you on bringing to us, in Illinois, the U.S. Senate. It's very vital, because we've had an opportunity, many times, to visit you there, and, certainly, look at some of the programs and efforts you are making. I recently returned from Korea, where I was honored by that Government. I had a chance to represent Governor Thompson and the State of Illinois, and through the letters which you furnished to the Embassies, to visit with the Korean Minister of Energy as well as the Minister of Energy of Japan, and many of the private sector as well as the governmental sector, talking to them about Illinois coal and, basically, midwestern coal. In all cases it was that they would be happy to buy our coal, but they would like to know how they can burn it environmentally safe if we can't do it ourselves. So, I think it's as vital that we continue the kind of research and have the capability and the ability if we're ever going to be able to take this vast resource, this Saudi Arabia that you described at our feet here, and move it out as a product. Certainly Illinois is one of the No. 1 inland States on exports. We certainly have a position here where we are, in the 1980's, going to be taking care of food, but, certainly, energy and the power in that area is reflected right here within the State of Illinois.

I am vice chairman of the Illinois Energy Resources Commission, as well as I serve as chairman of the national committee on the National Conference of State Legislators Committee on Energy. And, in that capacity, I was very pleased to listen to what you had to say in the Senator's reports about the concerns about the reorganization. We too will be taking some positions later this year—in fact, in our meeting in April, in Washington, and I would like to have a chance to confer with you on that and get your views and recommendations so that we can at least reflect that through all the State legislatures throughout the United States. As well as, hopefully, we, in Illinois, which we have a commitment of some $70 million to put into coal research and development. And, certainly, I was one of the sponsors of the program that set up a coal research board here in the State of Illinois. They had their first meeting here, 2 weeks ago.

One other thing that I would hopefully do is that, we have a hotline that I use, a technical hotline, and that is to confer with the six deans of engineering within the State of Illinois. Certainly, our dean, from Northwestern, is here with us today. And, I would say that this week, hopefully, I can ask them for some input, which I will support with my official presentation to you their concerns on the relationship between the universities, the Government, and ourselves.

And, finally, let me close by telling you this. We are, indeed, grateful for the kind of effort that has been made by the private, the public and the governmental sectors. Where, some 250 individuals, through the offices and under the direction of Dr. Jim Hartnett, from the University of Illinois, worked together with me, as the chairman of that committee and put out six documents, I think that will bring about the need for the kind of research and the kind of programs that are needed here in Illinois and the energy programs of the future. I thank you again, very much.

Senator PERCY. I appreciate that very much.

Now, with great pride and pleasure, I introduce the State representative from this great district, Diana Nelson.

TESTIMONY OF DIANA NELSON, STATE REPRESENTATIVE, 6TH DISTRICT OF ILLINOIS

Ms. NELSON. Good morning, Senator Percy.

My district, the Sixth District, includes Argonne and 23 surrounding communities. In Springfield, I serve on the energy and environment committee. I speak today, for the grassroots—for my constituents and for our children, who will be the ultimate beneficiary of the technological breakthroughs that Argonne has been responsible for in the past. We need to stand firm in opposition to further budget cuts that would be devastating to this community and to the lab.

Six hundred people are gone as a result of fiscal year 1981 budget cuts. Dr. Ken Yield is now with Motorola. The last postcard I got from the Sherrys was postmarked, "Texas." Now, 200 more jobs are to be RIF'd. The nonnuclear, that is, the fossil and conservation budget segment, is reduced from $1 million to $200,000, the solar budget is gutted and work not classified for military use is rejected. That is why I'd like to thank you very much, Senator Percy, for acting to focus on the problem now, while there still may be time.

We politicians need to be farsighted—to understand that we make decisions that will affect Illinois citizens for years to come. Our children will grow up in an America that is strong and free if we show foresight, and if we can admit that, maybe in our lifetime Federal tax cells may never be cost effective and cheaper than conventional power sources. But, perhaps in our children's lifetime—in Sherry's and Samantha's and Stephanie's, America will achieve reduced dependency on petroleum fuels and establishment of widely dispersed solar collectors. This can only occur in a climate supportive and deeply committed to the work of basic research.

Argonne National Laboratory is unique. It is the only national lab situated here in the center of a large, metropolitan, business-industrial complex that has multidisciplinary expertise. Dick Tracy is not the only character interested in fusion power—Argonne has been for years. Surely the Illinois delegation to Washington has the political smarts to insist that Argonne National Lab remain strong and functional. Thank you very much. [Applause.]

Senator PERCY. We thank you very much, indeed. I have no questions, and I appreciate your presence very much.

[The prepared statement of State Representative Nelson follows:]

PREPARED STATEMENT OF STATE REPRESENTATIVE DIANA NELSON

Good morning. I am Diana Nelson, a state legislator representing this 6th District which includes Argonne and 23 surrounding communities. In Springfield I serve on the House Energy and Environment Committee.

I speak today for the grass roots—my constituents—and for our children who are the ultimate beneficiaries of the technological breakthroughs that Argonne has been responsible for in the past. We need to stand firm together in opposition to further budget cuts that would be devastating to the community and to the work of the lab.

Six hundred people are gone as a result of the fiscal year 1981 cuts. Ken Nield is now with Motorola. The last post card I received from the Sherrys (Bill and Elizabeth) was postmarked Texas. (She took early retirement and they are on an extended tour of the United States in their motor home.)

Now: (a) 200 more jobs are to be RIF"d (reduction in force); (b) the nonnuclear, that is, fossil and conservation budget segment is reduced from $1 million to $200,000; (c) the solar budget is gutted; and (d) work not classified for military use is rejected.

That is why I would like to thank Senator Percy for acting to focus on the problem now while there's time. We politicians need to be far sighted to understand that we make decisions that will affect Illinois citizens for years to come. Our children will grow up in an America that is strong and free if we show foresight enough to admit that in our lifetime photovoltaic cells may never be cost effective and cheaper than conventional power sources, but perhaps in our children's lifetime America will achieve reduced dependency on fossil fuels and establishment of widely dispersed solar collectors. This can only occur in a climate supportive and deeply committed to the work of basic research.

Surely the Illinois delegation to Washington has the political smarts to insist that Argonne National Lab remain strong and functional.

Argonne National Laboratory is unique. It is the only national lab situated in the center of a large metropolitan business-industrial complex that has multi disciplinary expertise. Only an Argonne could produce the nation's only power-producing breeder reactor, and Automated Reasoning Assistant, techniques for decontaminating the damaged Three Mile Island power plant, a leukemia-fighting drug, a catalyst for converting coal products into alcohol, and 20 percent more powerful fuel cells.

Dick Tracy is not the only character interested in fusion power. Argonne has been for years.

This then is our best defense. Illinois desperately needs to improve its manufacturing base. Many of our heavy manufacturing jobs in steel works, automotive, or farm implements are disappearing with a changing world. Argonne and Fermi Labs are stellar attractions for the newer technologies that may go elsewhere if we don't act to bolster our own research facilities. Furthermore, unsolved problems remain. The economic feasibility of solar power and the safe disposal through recycling or neutralization of toxic wastes are but two examples. Argonne National Lab exists for the purpose of providing this kind of high risk technological research.

I compliment Senator Percy for this extraordinary show of support, of solidarity.

Our goal is the creation of jobs in Illinois.

Senator PERCY. We have two outstanding panels left now, and I'm going to ask the lab directors to defer and go last. We'll now have the panel consisting of Dr. Stanley Ikenberry, president at the University of Illinois; Dr. John Todd Wilson, president emeritus at the University of Chicago; Dr. Bruno Boley, dean of the technical institute at Northwestern University; Dr. Robert Pry, director of research for Gould, Inc., in Rolling Meadows; and Joe Spivey, director of the Illinois Coal Association. And, we also have Wallace Behnke, vice president, Commonwealth Edison.

We're running about 10 minutes behind schedule. I think each of you have been advised and have agreed upon an approximate length of your presentation. The full context of your testimony will be incorporated into the record. And, incidentally, we'll be happy to see that anyone who wants a full printed copy of this record will be, it will be made available to you if you just give a request to me through Dr. Massey's office.

First, with great pleasure, a strong friend, whose hospitality I've enjoyed many times—Dr. Ikenberry, president of the University of Illinois.

TESTIMONY OF STANLEY O. IKENBERRY, PRESIDENT, UNIVERSITY OF ILLINOIS, URBANA, ILL.

Mr. IKENBERRY. Thank you, Senator.

It's a pleasure to be here today to review the role our national laboratories play and to outline their special value to universities in the region. The University of Illinois has been deeply involved in the governance and research programs of the Argonne National Laboratory since the founding of the Council of Participating Institutions in 1946.

One of the principal functions of national laboratories is to serve as "holders in trust" of major scientific facilities. These facilities and the research programs they support are beyond the ability of individual institutions to finance, to build, or to operate. Yet, they're critical to the research objectives of many academic scientists, as well as to the interests of our Nation.

A second major function of the national labs is to invest in high-risk research programs which have promise of long-range returns. The national labs are uniquely equipped to attack basic scientific questions of major significance, questions which require collaboration by academic, industrial, and Government scientists, over many years. Historically, the Argonne National Laboratory has attacked problems in the development of peaceful application of nuclear energy. It was instrumental in making many discoveries which lead to controlled fission in the development of nuclear power reactors. Argonne continues to work at the forefront of this field, with a considerable portion of its effort devoted to the breeder reactor technology program. I should add that the fossil-fuels research being done at Argonne will be especially important to the State of Illinois as this State attempts to find the most economically and environmentally sound ways to use the relatively high-sulfur coal found in large quantities in Illinois.

It's apparent that the national laboratories represent an enormous investment; they are the frontline, scientific foundation that supports this Nation as a leading scientific power. We must use the labs fully to realize this potential. The multipurpose labs, like Argonne, put a broad spectrum of sophisticated scientific and technological resources at the disposal of Government, which can be mobilized to meet national needs. Not coincidentally, however, they also meet the needs of the academic community as it proceeds with our mission. The location of national laboratories across the Nation enables exchange among academic researchers from leading universities. Indeed, the history of leading departments and certain disciplines shows a very close relationship with the national laboratories. The labs could not develop fully without the expertise and advice of leading academic scientists; but, without access to the most advanced facilities such as Argonne, on the other hand, many leading departments could not have attracted leading scientists to our institutions.

The University of Illinois has had strong relations with both Argonne Laboratory and Fermilab; the benefits of these relationships have been mutual, I believe.

I'd like to make a final point regarding the value of the national labs in revitalizing the economy of the Midwest. As Governor Thompson noted, I have served as cochairman of the Governor's

Task Force on High Technology. It was our charge to develop recommendations to enhance high-technology industry in Illinois. Significant among the assets of Illinois are the two national laboratories—Fermi and Argonne. The people working in our universities and in our laboratories now, represent a network of talent of great value to this State and to our Nation. The State of Illinois must depend on the continued high performance of the Fermi Lab and the Argonne Lab as part of our strategy to stimulate economic growth and development.

Mr. Chairman, this concludes my remarks, and I'm delighted to be with you today.

Senator **Percy**. Thank you, Dr. Ikenberry, very much indeed.

Many of the great contributions that the University of Illinois has made through the years has helped carry this Nation from a country 90 percent engaged in agriculture—90 percent of the workers at one time engaged in agriculture—to a day where, today, less than 4 percent of our people engage in agriculture. We not only feed ourselves, we ship more food to the rest of the world than all the rest of the world combined—an absolute miracle! And, that's just one of the many accomplishments that the University of Illinois has helped with.

Another thing: You, as an institution, educate and train more electrical engineers than any other educational institution in the world. With those accomplishments behind you, what would be the impact on, say, the University of Illinois as a great educational institution if the present trend goes along and if we simply are severely cut back at Argonne?

Mr. **Ikenberry**. Well, Senator, I'm here this morning to express our hope that that does not occur. The University of Illinois, as other universities in the State of Illinois and throughout this region, have close and productive relationships with the Argonne National Laboratory. We believe these ties are critical to the development of our academic programs. Our faculty members are closely involved in the work of the laboratory, both as consultants in the work of the laboratory and through access to highly sophisticated facilities that are available here for the pursuit of research. Our graduate students pursue, for example, their Ph. D. dissertation research in cooperation with Argonne Laboratory, with scientists here and through these facilities. We view these as very much a part of the academic and scientific community of the State of Illinois, and that's why I'm pleased to be here.

Senator **Percy**. In your judgment, are the large grants that have been received by research institutions on both coasts—through the years now, the last 20 years particularly—been responsible for the great growth, also, of our educational institutions—the prosperity of them, and the general prosperity of the country, which has exceeded the growth rate, certainly, of the Middle West?

Mr. **Ikenberry**. We do see a very direct tie between the ability of the University of Illinois, for example, to grow in quality and stature in its academic programs and the availability of these laboratories. You mentioned earlier, our college of engineering, which has a larger sponsored research program than any other public university in the country. The physics department of our university is located in the college of engineering. I dare say, it would have been impossible, over the years, to develop a physics department and a program of engineering research such as has been achieved, not only at our university, but other universities in this region, without the benefit of access to the facilities here at Argonne.

Senator **Percy.** The final question: Even though you turn out a larger number of electrical engineering graduates than any other institution in the world, it seems to me, we're losing a very high proportion of those, who leave the State. What's the cause for this "brain drain?"

Mr. **Ikenberry.** Well, we view this as a great potential strength in the State of Illinois, and that is, the possibility of attracting and retaining larger numbers of these engineering graduates to remain in the State of Illinois. We find, in our surveys, that the students would much prefer to remain in their native State. As you know full well, Senator, in the case of the University of Illinois, well over 90 percent of the students that we admit to the engineering program are natives of this State. And, they've indicated to us, that in very high proportions, they would prefer to remain in this State. One of the problems is finding attractive, feasible employment for those graduates. That's why the Fermi Lab is important in that regard, and that's why the Governor's and the mayor's task forces on development of high-technology industry in Illinois and the Midwest are also important.

Senator **Percy.** Thank you very much.

[Dr. Ikenberry's prepared statement follows:]

TESTIMONY PRESENTED BEFORE THE U.S. SENATE COMMITTEE ON GOVERNMENTAL AFFAIRS, SUBCOMMITTEE ON ENERGY, NUCLEAR PROLIFERATION AND GOVERNMENT PROCESSES, MARCH 22, 1982, BY DR. STANLEY O. IKENBERRY, PRESIDENT, UNIVERSITY OF ILLINOIS

Mr. Chairman, I am Stanley O. Ikenberry, President of the University of Illinois. We are the major public research university in the State of Illinois with campuses in Urbana-Champaign and Chicago. The University of Illinois is one of 51 members of the Association of American Universities. About 35 percent (18 of 51) of the AAU institutions located in 12 different states were members in 1981 of the Argonne Universities Association; the same number were members of the Universities Research Association, the Fermi National Accelerator Laboratory's governing body. These universities have national and international missions. Collectively, they train a large share of the nation's scientists and engineers. Increasingly, we recognize the need for these leaders in research and graduate education to join with government and industry in working to solve the most complex yet most serious challenges which face us as a nation.

Additionally, the University of Illinois has been deeply involved in the governance and research programs of the Argonne National Laboratory since the founding of the Council of Participating Institutions in 1946. It is, therefore, a pleasure for me to join you here today to review the role our national laboratories play and to outline their special value to universities in the region.

One of the principal functions of national laboratories is to serve as holders in trust of major scientific facilities. These facilities, and the research programs they support are beyond the ability of individual institutions to finance build, and operate. Yet they are critical to the research objectives of many academic scientists as well as to the interests of the nation.

In Illinois, the Fermi National Accelerator Laboratory (Fermi Lab) was established to house the world's largest particle accelerator. It is a user-oriented facility in which (predominantly) academic scientists from universities make use of a unique resource to advance basic knowledge about the ultimate structure of matter. The only comparable facility in the world is a twin facility operated by a consortium of Western European nations in Geneva, Switzerland. I understand that this facility is funded at about three times the level of Fermi, giving it an advantage in this crucial field. Fermi remains this nation's most powerful elementary particle research facility and the ability of the United States to remain competitive depends upon the ability of the scientific community to use this laboratory. It is a facility in which over one billion dollars have been invested and stands as a superb example of the unique role the federal government can and must play in support of fundamental science.

A second major function of the national laboratories is to invest in high risk research programs which have promise of long range returns. The national laboratories are uniquely equipped to attack basic scientific questions of major significance, questions which require collaboration by academic, industrial, and government over many years.

Historically, the Argonne National Laboratory has attacked problems in the development of civilian (non-defense) nuclear energy. It was instrumental in making many of the discoveries which led to controlled fission and the development of nuclear power reactors. Argonne continues to work at the forefront of this field, with a considerable portion of its effort devoted to the breeder reactor technology program.

The unique facilities and expertise of the Argonne Laboratory were called into play on broader questions of meeting the energy needs of the nation. It has become apparent over the past decade that new approaches would be essential. National policy makers recognized that an increasing dependence on foreign sources of energy could cripple the nation's economy and our national security. Consequently, resources have been applied to research on fossil fuel utilization, solar energy, and conservation techniques. Argonne has addressed these questions and continues to focus special attention on nuclear energy.

In addition to addressing a major national problem with a concerted effort, Argonne has put its expertise to work in areas like materials research and environmental and health-related problems. The result has been a versatile research facility capable of addressing many issues. As our energy situation continues to change, the nation will benefit if it holds together the scientific, technical, and physical facility assets it has so painstakingly assembled at Argonne. I should add that the fossil fuels research being done at Argonne will be especially important to the State of Illinois as this State attempts to find the most economically and environmentally sound ways to use the relatively high-sulfur coal found in large quantities in Illinois.

It is apparent that the national laboratories represent an enormous investment. They are the front-line scientific foundation that supports this nation as a leading scientific power. We must use the labs fully to realize this potential. The multi-purpose labs like Argonne put a broad spectrum of sophisticated scientific and technological resources at the disposal of government which can be mobilized to meet national needs. Not coincidentally, they also meet the needs of the academic community as it proceeds with its mission.

The location of national laboratories across the nation enables exchange among academic researchers from leading universities. Indeed, the history of leading departments in certain disciplines shows a close relationship with the national laboratories. The labs could not develop fully without the expertise and advice of leading academic scientists; without access to the most advanced facilities on the other hand, many leading departments could not have attracted leading scientists to their faculties.

High energy, elementary particle physics has, in the past, played such an important role at the frontiers of research in fundamental physics that a first class physics department could not survive without an active program of research in high energy physics. In order for graduate students to have exposure to theoretical concepts, it was and is essential to have elementary particle theorists on the faculty of a physics department. Such theorists require access to experimental activity in their field.

It was that requirement which led, in the late 1950s, to a critical situation among midwest universities. Major high energy physics accelerators existed on the east coast and on the west coast. No significant facility existed in the midwest, although much of the work in the previous generation of high energy physics had been carried out at the University of Chicago, at the cyclotron built by Enrico Fermi at that campus, and at the University of Illinois using the Betatron built by Donald Kerst on that campus. When that field of research outgrew that generation of accelerators, the new super-accelerators were located on the east and west coasts. As a result, midwest universities found it difficult to attract and maintain high energy physics research groups. The inability to maintain such research groups jeopardized the strength of physics departments, as a whole.

It was in that era that Midwest universities, in an attempt to reestablish their competitiveness in high energy physics, developed a consortium for the purpose of doing fundamental research in the area of particle accelerators with the idea, eventually, of constructing a major facility which would be competitive with those on the east coast, on the west coast, and in western Europe and the Soviet Union. Ultimately, these efforts led to construction of an accelerator at Argonne, and subsequently to the establishment of Fermi Lab to house the world's largest particle accelerator.

Fermi Lab has been the source of some of the most dramatic advances in elementary particle physics in the past decade. Those experiments have been done by physicists from all over the nation and the world. Proximity to Fermi Lab has been an important factor in the renewed ability of the major universities like Chicago, Purdue, Wisconsin, Michigan and Illinois to recruit and to retain strong elementary particle physicists in their physics departments and in related fields.

The University of Illinois has had strong relations with both Argonne and Fermi. The benefits of these strong relationships have been mutual, I believe. Forty-two members of the faculty of the University of Illinois served as consultants at Argonne in 1980–81. Twelve members of the Argonne technical staff also taught courses at the University of Illinois. Seven University of Illinois graduate students conducted their Ph. D. dissertation research at the Lab.

Thus, the relationships between the University of Illinois and Argonne have been extensive and close. The mutual benefits are substantial.

I would like to make a final point regarding the value of the national labs to revitalizing the economy of the Midwest. Recently I have served as cochairman of a Governor's High Technology Task Force. It was our charge to develop recommendations to enhance high-technology industry in Illinois. Significant among the assets of Illinois are the two national laboratories—Fermi and Argonne. The people now working in our universities and in the laboratories form a network of talent of great value to this State. Illinois will depend on the continued high performance of the Fermi Lab and the Argonne Lab as part of its strategy to stimulate economic growth and development.

Mr. Chairman, this concludes my remarks. The University of Illinois, and this State and region are the beneficiaries of these important national laboratories. We welcome your attention to preserving and enhancing the laboratories as a national and regional resource at a time when this nation's strategic position as a scientific leader depends heavily on the wise use of human talent, sophisticated facilities, and equipment. I emphasize the importance of the laboratory to the joint interests of the academic community, to our economic heatlh, and to the national interest.

Senator PERCY. Our next guest, Dr. John Wilson, and I have sat together in so many board meetings at the University of Chicago, that it's a particular pleasure to welcome you to this version of the "United States Senate Board Meeting," and to thank you, publicly, for the great contribution you've made to the education of Chuck Percy, insofar as the value of higher education and scientific research to the Nation.

TESTIMONY OF JOHN TODD WILSON, PRESIDENT (EMERITUS), THE UNIVERSITY OF CHICAGO, CHICAGO, ILL.

Mr. WILSON. Thank you, Mr. Chairman. It's a pleasure to be here, and I echo Mrs. Gray's personal thanks, and the thanks of the university to this subcommittee for meeting today at Argonne National Laboratory. As you've pointed out, I am president emeritus of the University of Chicago. It's in that capacity that I'm substituting for Mrs. Gray, who had a prior commitment elsewhere.

I think the location of this hearing is most appropriate. Argonne National Laboratory has, since its founding almost 4 decades ago, provided the Nation with important research in the fields of energy—both nuclear and nonnuclear. Needless to say, the University of Chicago is proud to be associated with the Argonne National Laboratory since its beginning. In fact, the basis for our relationship with Argonne goes back even further than that. As has been mentioned here this morning, the first self-sustaining nuclear chain reaction was achieved by Enrico Fermi and his colleagues, nearly 40 years ago, under the stands of the Stagg athletic field of the university.

For 20 years, the university was the sole contractor for the management of Argonne. For the last 15 years, the university has been a contractor under a tripartite agreement with the Government, with Argonne Universities Associates, a group of 30 universities located chiefly in the Midwest, but extending from Pennsylvania to Arizona. The university, and the AUA, in the last few months, have been engaged in discussions to find ways of further strengthening the management of Argonne. The university has developed a plan for the return of the management of Argonne to the university as sole contractor.

The basic principles guiding the development of the University of Chicago plan are that it should achieve the following goals:

One, it should provide the Department of Energy or the successor Government agency with a single contracting party that would be responsible for the direction, operation, and management of the laboratory.

Two, it should provide for a wide range of information and assistance from other universities and from high-technology industries in determining policies for the direction, operation, and management of the laboratory.

Three, it would provide a broadbased group of highly qualified individuals to give direction and advice to the laboratory director and to his senior staff.

Four, it should assure access to laboratory facilities and programs by qualified scientists and engineers from universities and from relevant industries.

In order to achieve these goals, the board of governors, responsible for the policy direction, the long-range planning and the management of the laboratory will be established. The membership of this board would include University of Chicago trustees, officers, and faculty, as well as scientists, engineers, and administrators from other universities and high-level representatives from industry. It is against this background that I would like to make several broader comments.

Policies that have guided our national scientific research and development effort since World War II, have utilized relationships that involve the university community, the national laboratories, the private sector of the economy, and the Government itself. These relationships have permitted interactions that have brought about great advances in human knowledge and the applications of that knowledge. We are now in a period when the role of Government in this collaborative effort is being questioned—with the support of the national laboratories being a critical aspect of that questioning. I believe it is most important for the

Congress to recognize its contribution to the establishment of the national research and development effort, and to enter, vigorously, into the discussions that will determine the continuing role of the Federal Government in the future of that effort.

The budget decisions of 1982 will control more than just the deficits of 1983. These budget decisions will shape, for many years, the ability of the national laboratories and the universities and the secondary school systems to continue their roles as important research centers and science education centers.

The University of Chicago is working, along with the other universities in this region to make it known that the Midwest is a place where significant developments in science and technology are occurring. Scientific progress requires an intellectual climate of challenge—an exchange in which the academy, the national laboratories, and industry each make their important contributions and from which they draw their benefits. Such a climate in this day is not a luxury—but a requirement to attract and stimulate the best minds. We believe we have it in the Midwest, and the national laboratories represented here are an important part of this effort. Thank you very much.

Senator **Percy**. Thank you very much, Dr. Wilson.

I know that it's been, probably, as upsetting to you as it has been to me to constantly get indications that the United States is stepping behind other nations in science and research. I find it difficult to believe, and really impossible to accept. How did this come about, and what do you think we can do about it?

Mr. **Wilson**. Well, as you note, Senator, I was for many years associated with the National Science Foundation before coming to the University of Chicago, and for the last 5 years prior to coming to the university, I was the Foundation's Deputy Director. In that effort, it was our concern that the support of the total research and development effort of the country, including that of the universities, that of the national laboratories, that of the land-grant schools, and that of the private economy be so meshed and be so supportive on a rational basis that we would have an ongoing research effort and an ongoing science education effort that would, indeed, not experience the ups and downs and the disruptions that you've mentioned.

I've been warned by our public relations people not to use the word matrix, but this is a matrix, indeed. And, when you disrupt any one part of the matrix, it effects the whole matrix. I believe it is terribly important that we not go further in disrupting both the basic research effort—the effort of the national labs as they contribute to regional activities and regional support of universities and secondary school systems, and the science education effort both at the college and the precollegiate levels.

Senator **Percy**. You do teach a seminar at the university on the relationship between Federal Government and higher education. We have a proposal. after creating a Department of Education—I sponsored that legislation—to dismantle that, which I oppose. I think we were the only country in the free world that did not have a minister-level education spokesman, and I think we need that kind of spokesman. What kind of relationship—what can we do to improve the relationship betwen higher education, especially sciences, and the Federal Government?

Mr. WILSON. Well, I am as concerned at the secondary school as I am at the higher education level. Our seminar covers relationships between the Federal Government and various education levels, but the flowdown from higher education into the secondary school system is of special importance. The problem, as I see it at the moment—if one were to think of science as having an offshoot which goes toward technology and an offshoot that goes toward education, the relationship between the science programs and the higher education programs are currently suffering, particularly I think, at the graduate fellowship level. I would continue the general predoctoral and postdoctoral fellowship programs at a very high level within the National Science Foundation. Furthermore, I would not do what has been done in the last two budgets with respect to the precollegiate science education program.

It's my observation that one of the most difficult aspects of Federal Government support programs in education, whether they're science education or more generally conceived, is their articulation with State programs. And, I do believe that there is a real shortcoming in the way, historically, the science education programs have not made an articulation with State education programs. The adoption of curricular materials has been very spotty, and the relationship between the university system and the school systems in the States and regions, so far as science education is concerned, is not nearly what it ought to be. At the moment, if one were looking for a model of how a given State is handling the problem particularly well, both with respect to science and technology and science and education, I would suggest that the people in Illinois, who are on the Governor's committees, take a look at what has happened in the State of North Carolina.

The Governor of the State of North Carolina has recently publicly reported that, as a result of the formation of a Governor's research and development board and the relationship which he has established between the research triangle of the State's universities, the school systems, and business and industry over the past 5 years, there has been $2 billion additional industrial development in North Carolina. And, most recently, they have done a very interesting thing—they have established a State high school for science and mathematics at the junior and senior years on the campus, I believe it's at Durham. And, I should say, parenthetically, they've also established a State high school for the performing arts, so that they're not just biased toward research and development and science. This science high school is aiming for 700 students in its first graduating class this June. I think it is one of the most exciting developments in the United States.

Senator PERCY. Thank you, Dr. Wilson.

[The prepared statement of Hanna Holborn Gray, president, the University of Chicago follows:]

STATEMENT OF HANNA HOLBORN GRAY, PRESIDENT OF THE UNIVERSITY OF CHICAGO, BEFORE THE SUBCOMMITTEE ON ENERGY, NUCLEAR PROLIFERATION AND GOVERNMENTAL PROCESSES OF THE GOVERNMENTAL AFFAIRS COMMITTEE, U.S. SENATE, MARCH 22, 1982

Mr. Chairman, I want to express my personal thanks and the thanks of the University of Chicago to this Subcommittee for meeting today at Argonne National Laboratory. The location for this hearing is most appropriate. Argonne National Laboratory has since its founding almost four decades ago provided the nation with important research in the fields of energy—both nuclear and non nuclear. The University of Chicago is proud that it has been associated with Argonne National Laboratory since its beginning. In fact, the basis for our relationship with Argonne goes back even further than that. The first self-sustaining nuclear chain reaction was achieved by Enrico Fermi and his colleagues nearly 40 years ago under the stands of the Stagg athletic field of the University.

Our ties to Argonne, then, are deep and strong. For 20 years the University was the sole contractor for the management of Argonne. For the last 15 years the University has been a contractor under a tripartite agreement with the government and the Argonne Universities Association, a group of 30 universities located chiefly in the midwest, but extending from Pennsylvania to Arizona.

The University and AUA in the last few months have been engaged in discussions to find ways of further strengthening the management of Argonne. The University has developed a plan for the return of the management of Argonne to The University as sole contractor.

The basic principles guiding the development of The University of Chicago plan are that it should achieve the following goals:

Provide the Department of Energy with a single contracting party that would be both responsible and accountable for the direction, operation, and management of the Laboratory.

Provide for a wide range of information and assistance from other universities and from high technology industries in determining policies for the direction, operation, and management of the Laboratory.

Provide a broad-based group of highly qualified individuals to give direction and advice to the Laboratory director and his senior staff.

Assure ready access to Laboratory facilities and programs by qualified scientists and engineers from universities and from relevant industries.

In order to achieve these goals a Board of Governors responsible for the policy direction, long-range planning and management of the laboratory will be established. The membership of this Board would include University of Chicago trustees, officers, and faculty as well as scientists, engineers and administrators from other universities and high level representatives from industry.

Since 1946, the people working at this Laboratory have been employees of The University of Chicago. We recognize our responsibility to these employees and to the nation to maintain at Argonne a facility of the highest quality.

Therefore, I speak to you today both as the President of The University of Chicago, an institution involved in and deeply committed to basic research, and as a person with responsibilities for the management of this important national resource.

This dual role provides some perspective for gauging the roles of the national laboratories in relation to the other institutions of higher education. The University mission and the Laboratory mission are two aspects of the same set of responsibilities. Universities and national laboraotries are both involved in the enterprise of increasing knowledge and improving the human condition. Yet, laboratories have certain unique qualities:

They are particularly well suited to specific areas of research and have the ability to organize to provide fast responnses to national needs. An example is the work of the laboratories during the energy crisis.

Further, certain large and expensive equipment, such as the Fermi accelerator or the Argonne Intense Pulse Neutron Source (IPNS), can be appropriately located at a national laboratory where it can be made available to researchers throughout the country. Certainly, in those two instances, the equipment has been of value to researchers in the universities throughout the Midwest.

The national laboratories have been the appropriate places for the handling of large, integrated complex and multi-disciplinary research projects of national scope.

The national laboratories allow historic development of expertise to deal with the nation's problems. I would point, for example, to the long recognized expertise at Argonne in nuclear technology.

The relationship between the universities and national laboratories in the Midwest is collaborative. Argonne has worked, in a number of ways, with over 200 colleges and universities in the last year alone. The facilities at Argonne have been used by a network of physics departments throughout the midwest at schools such as Michigan, Illinois, Wisconsin, Ohio State, Northern Illinois University, and others. Although these facilities are available nationally and even internationally, midwestern universities, because of their obvious geographical proximity, have benefited the most from these facilities.

Argonne last year expended more than $5 million in contracts and subcontracts to colleges and universities and other educational institutions for research activities. That same year Argonne expended more than $3 million for the employment of temporary employees and visiting faculty members from universities to work at the laboratory and more than $2 million in educational programs and conferences.

Additionally, over 400 university personnel last year participated in programs at Argonne ranging from postdoctoral visits to collaborative research and joint appointments.

There is an interchange of personnel regularly between universities and Argonne. It enables people to get a different range of experiences and makes Argonne National Laboratory a part of the higher education community. This greatly benefits the universities as well as the laboratory. The real benefit however is to the research endeavor and to our nation.

Argonne National Laboratory is an important part of the midwest's higher education activities, and the relationships and exchanges between Argonne and the region's industry are increasing. These relationships not only strengthen Argonne, but they strengthen the attractiveness of the midwest as a place for industry to locate.

It is against this background that I turn to several broader issues. Policies that have guided our national scientific research and development effort since World War II have utilized a relationship that involves the university community, the national laboratories, the private sector of the economy, and the government itself. These relationships have permitted interactions that have brought about great advances in human knowledge and in the applications of that knowledge. We are now in a period when the role of government in this collaborative effort is being questioned, with the support of the national laboratories being a critical aspect of that questioning. I believe it is most important for the Congress to recognize its contributions to the establishment of the national research and development effort and to enter vigorously into the discussions that will determine the continuing role of the federal government in the future of that effort. The budget decisions of 1982 will control more than just the deficit of 1983. These budget decisions will shape for many years the ability of the national laboratories and the universities to continue their roles as important research centers.

While there have been nominal increases annually, and this present budget proposes such increases, federal government support for basic research in real terms is no different today than it was in 1967. Support for applied research is actually less than it was in 1967. Technology over the last 15 years has not been constant. Costs of research have not been constant. And the cost of research equipment which quickly becomes obsolete has not remained constant. All these costs have risen faster than federal support.

Each year then it gets harder and harder to maintain the quality of our research. The equipment in university laboratories is often not at the level of the state of the art. Proposals for special funding to meet these needs have not been successful. The Office of Management and Budget in recent revisions to Circular A-21 has proposed the allowance as indirect costs of certain interest costs for new facilities and laboratory equipment. While this is far from a complete answer, it is an appreciated recognition of the problem.

The reduction in federal support we have seen over the last few years for higher education, including recent proposals to reduce National Institute of Health overhead payments and eliminate graduate students from the guaranteed loan program, is mirrored in reductions faced by national laboratories. Argonne itself has over the last several years reduced its work force by 12%. This represents 600 people. We cannot reduce research teams today to meet today's budget and expect to resurrect them in time to meet tomorrow's needs. There must be a continuity of effort, a continuity to the research enterprise.

The University of Chicago is working along with the other universities in this region to make it known that the midwest is a place where significant developments in science and technology are occurring. Scientific progress requires an intellectual climate of challenge and exchange in which the academy, the national laboratory and industry each make their important contributions to draw benefits. Such a climate in this day is not a luxury but a requirement to attract and stimulate the best minds. We believe we have it in the midwest. The national laboratories represented here are an important part of this effort.

Senator **Percy**. Our next guest, Dr. Bruno Boley, dean of the technological institute at Northwestern University. I doubt that you know, I was enrolled as a student in 1946 there, because the engineers at Bell & Howell were so confusing me that I went over to pick up a couple of courses, particularly in drafting and blueprint reading.

You were born in Italy, immigrated to this country in 1939, and since then, you've become looked upon as one of the top engineering professors in the United States. Dean Boley, we look forward to your statement.

TESTIMONY OF BRUNO A. BOLEY, DEAN, TECHNOLOGICAL INSTITUTE, NORTHWESTERN UNIVERSITY, EVANSTON, ILL.

Mr. **Boley**. Thank you very much, Senator Percy. You're welcome to Northwestern University any time. We have some more advanced courses that you could take. [Laughter.]

Senator, I subscribe fully to the statements by my colleagues on this panel regarding the importance of strong collaboration between the national laboratories and universities. I believe that this sort of collaboration is essential. I think that this is a way in which facilities and personnel are brought together in a combination of talent, of expertise and of equipment, in a synthesis which is always, in my mind, larger than the sum of its parts. In the interest of brevity, I would like to focus on just one point which, perhaps, has not been sufficiently emphasized.

The work that the laboratories do, that the Government does through the laboratories and, particularly, its collaboration with the universities, gives the Government an opportunity to partake in this meaningful work. But I would like to submit that, what we need in addition is continuity and reliability—demonstrated steadfastness of purpose in the Government that R&D will be supported; and it is important. If we do not have that, I do not see how we can attract more and brighter young men and women into the engineering and science professions and give them the notion that there is a future in which we believe. Senator, I believe that we need to establish credibility in that area, and I believe that the Federal Government has an important part to play in that regard.

Senator **Percy**. Thank you very much indeed. [Applause.]

We have mentioned before, the fact that scientific and technical manpower in the world seems to be getting disproportionate. Twenty percent fewer engineers are being trained in the United States than in Japan; a country that has half our population. What are the long-term implications for the United States if this emphasis on engineering continues in other countries in contrast to some reductions here?

Mr. **Boley**. I cannot imagine that the result of this would be anything but a further slippage in our national expanse—our national comparison with regard to other countries. The supply of engineers—I'm told, quite often, in Japan—that the statistics are misleading—that they do all kinds of jobs that, perhaps, our engineers do not. I think that the numbers are sufficiently diverse—of sufficient dispirit—that, even if you account for those, they are producing a much larger number than we do in an effective way. If we do not provide numbers that are adequate, I think that we would find that R&D will suffer, I think that we will find that an increasing number of foreign students will be coming to our shores and bringing our skills and advanced expertise to their own, and, I think that we will simply go further and further behind.

[Mr. Boley's prepared statement follows:]

PREPARED STATEMENT OF DR. BRUNO A. BOLEY

I am pleased to have this opportunity to present my views on the relations between government laboratories and universities, a subject which I consider to be of major importance to the national welfare.

To put my testimony in perspective, a few words about my own background might be useful. I have been trained as a civil and aeronautical engineer, and have worked both in industry and academe in structural and mechanical problems in those fields, as well as in the field of nuclear engineering. My present position is that of dean of the Technological Institute at Northwestern University, that being the name of our engineering school, and in position I have occasion to observe and appreciate the association of a large number of my faculty with the laboratories, particularly Argonne, in ways which I will discuss presently. In addition, in recent years I have been closely involved with a number of activities at the National Academy of Engineering related to the respective roles of industry, university, and government in research and development, engineering education, and manpower supply.

Relations between government laboratories and universities should be viewed in the broader context of the federal role in R&D. Each of the three entities, the private sector, the universities, and the government, must play distinct but coordinated roles. The roles of industry and of university are fairly clear: industry to market goods and services for the public interest and therefore its own profit, and university to produce research and highly trained individuals. The role of government is essential in insuring that the proper climate exists for the others to perform these tasks. It must help define those tasks for the long-range economic, social, and military welfare of the nation; it must encourage, monitor, and guide, in a way which does not attempt to interfere with or sway market forces, but at the same time recognizes that industry—and to some extent, universities—find it easier to focus on relatively short-range and sharply focused issues, leaving it to the government to insure that the broader and longer range concerns are not overlooked.

From my university standpoint, high among these is the continued flow of technically highly trained individuals, and the support of engineering and science education that it implies. Thus, the role of government is essential if the entire technological fabric of the nation is to function effectively. The Federal Government exercises this role in a variety of ways, which includes such diverce elements as tax incentives, procurement contracts, research grants, support of technical education, and so forth. In addition, of course, it must itself get involved very closely in actual research. For example, problems which are either too large or complex to be operated by a single university or industry, or problems which are of a high risk but potentially long-range significant payoff, fall in this category. This leads to the establishment and operation of the national laboratories, which indeed are best suited for the performance of these kinds of tasks.

Although it is my opinion that the laboratories perform these functions well, it is not necessary to enter into a detailed description at this time since that has been done by other people testifying here this morning. What I would like to emphasize is the fact that, in order to perform the function well, the laboratories must engage in close cooperation with universities, and that this indeed results in a reciprocal relationship in which both sides gain.

There are four principal ways in which this collaboration takes place. The first involves visiting appointments for both faculty and students at the laboratories. These appointments give the laboratories access to some of the nation's top present and future scientists and engineers, who in turn profit by direct exposure to the state of the art problems and facilities being employed. Ideally this should be a reciprocal arrangement, and that greater stress can be put on insuring that this indeed is a two-way street with members of the scientific laboratory staffs participating more closely in teaching and research on university campuses. I believe that some of the laboratories are, in fact, planning to expand their activities in that direction, and I would like to encourage them to do so.

In a second mode of collaboration, the use of laboratory facilities is made available to faculty and students. By and large this involves equipment which is either too large or too expensive for individual universities to acquire, but which is nevertheless essential to them in the pursuance of their own research. The value of this sort of activity is obvious and great.

Thirdly, direct collaboratory research takes place. This occurs by contractual agreements of various kinds, and may involve research carried out either by the universities themselves or jointly by the universities and laboratories. Again, the key here is the fact that, both in the way of facilities and of personnel, combinations of talent, expertise, and equipment are brought together in a synthesis which is quite often larger than the sum of its parts. From the university's point of view, this is part of the larger support of science and engineering training and education, which the government must consider among its highest priorities if our competitive position with other industrial nations is not to deteriorate further.

Finally, an important part of the national laboratories/universities relation must rest on a continuing and broad exchange of technical information. Most laboratories successfully fulfill this need by the sponsoring of conferences, short courses, workshops, seminars, and the like. These not only bring the achievements of the laboratories to the attention of the scientific and engineering community, but at the same time serve to keep the laboratories abreast of advances in the field with minimal delay.

In all of these ways laboratories and universities work well together. Their collaboration is essential if optimal use of both facilities and personnel is to be achieved, and I would like to conclude with the hope that discussions among the pertinent groups will continue and indeed increase, so that existing methods of interaction are improved and new and additional ones are sought.

Thank you.

Senator PERCY. Thank you very much indeed.

For our next witness, we'll go to Wallace Behnke, vice chairman of Commonwealth Edison. A registered engineer, Mr. Behnke is the top technical person at Commonwealth Edison, and very active in the community and the engineering profession. We're very pleased to have you today to talk about Argonne's contribution toward making this country less dependent on foreign oil and how the private sector looks upon them.

TESTIMONY OF WALLACE B. BEHNKE, JR., VICE CHAIRMAN, COMMONWEALTH EDISON CO., CHICAGO, ILL.

Mr. BEHNKE. Well, thank you very much, Senator Percy. I appreciate this opportunity to summarize Commonwealth Edison's views on the critical need for energy research and development and the role that we see for the national laboratories. I know you're behind schedule, so, in the interest of brevity, I'll quickly summarize my prepared remarks, and I would appreciate it, Senator, if the prepared remarks would be included in the record of this proceeding.

Senator PERCY. The entire text will be incorporated into the record.

Mr. BEHNKE. Senator, as you know, our company serves 3 million customers in Northern Illinois, and about 90 percent of the electricity we produce comes from coal and nuclear energy. Both these two energy resources, of course, are resources that Argonne is doing a great deal of research on in terms of finding new and better ways to use them.

What concerns us is that, lower gasoline prices are already encouraging consumption and fostering a sense of complacency about our future energy supplies. The danger we see in this trend is that, with Federal expenditure curtailment, the mistaken judgment could be made that the Nation can afford to curtail or abandon important, energy-related research and development now underway at our national laboratories, including Argonne. If this were to happen, modest, near-term savings would eventually give way to higher prices, larger energy supply risks and greater environmental impacts.

Over the past 30 years, Argonne has been a center of scientific and technical excellence in the energy-related fields. It has been a major factor in the development of nuclear power, which currently accounts for 12 percent of U.S. electric energy production and 45 percent of the electricity produced here in the Chicago area. Now, no one can argue with the fact that the Nation is in serious economic difficulty, and that the time has come for the administration and the Congress to reassess national priorities in the light of the current realities. We believe, however, that it is a serious mistake for Congress to respond to budgetary pressures by cutting back on our national energy R&D commitments when other industrial countries are investing in substantial, long-term, energy R&D .

As for the allocation of the energy research and development task between government and the private sectors, we believe that industry should continue to take the lead in product-related R&D, but that the government must sponsor the bulk of the long-term, generic, energy R&D task. Obviously, both must share responsibility for the middle-ground of the R&D spectrum. The costs and risks of longterm, generic R&D are more than industry can handle; this is, clearly, a job for the national laboratories.

The national laboratories also must be maintained as centers of technical and scientific excellence, to serve as a resource for Government policymakers and regulators, and as an adjunct to our system of higher education. Argonne has been successfull fulfilling these roles for many years, and continues to do so today. Laboratories like Argonne are an essential cornerstone of America's energy policy. They represent a significant national asset in terms of facility and trained personnel that would be difficult, if not impossible, to replace in today's economic environment.

Without the generic, long-term R&D output of Argonne and other national laboratories, future generations would be committed to less secure energy supplies, higher costs, and adverse environmental impacts.

Senator, this includes a summary of my testimony; I'd be pleased to answer any questions that you might have.

Senator PERCY. Thank you, Mr. Behnke.

You do represent, certainly, one of the largest of the utilities in the United States, and I know that you share my commitment to finding alternatives to oil—we simply must do that. There are some who say that the Government just doesn't belong in the area of research, and in the areas of energy conservation and coal development and research, and budgets have been slashed. What impact will it have if we slash those budgets, as are proposed, on services that can be offered, our ability to innovate, and particularly, the effect on inflation and high interest rates, if, instead of putting the emphasis on conservation, we just simply have to go the "brute force route" and build more and more and more facilities to feel a system that is inefficiently using energy. Won't we, really, in the end, hurt all the way around if we cut back R&D?

Mr. **Behnke**. Well, Senator, as I indicated, research and development in the energy field, we believe, is an absolutely essential ingredient to national policy. Research, both on better ways to use our energy resources on the supply side, and research and development on ways to conserve energy on the demand side. Efforts to cut back on research and development now, true, could provide some relatively modest savings in Federal spending at this time, but the price we would pay for that on downstream would be very high. It would be very high, because, on the supply side, we would find ourselves locked in, for a long time with today's technologies; and on the demand side, we would deny ourselves new, innovative ideas that we could apply to make more efficient use of the energy resources we have.

Senator **Percy**. I thank you very much, indeed, for that answer.

[Mr. Behnke's prepared statement follows:]

STATEMENT OF WALLACE B. BEHNKE, JR., VICE CHAIRMAN, COMMONWEALTH EDISON CO.

My name is Wallace B. Behnke, Jr. I am Vice President of Commonwealth Edison Company, an electric utility serving approximately 3.0 million customers in Chicago and northern Illinois. I am also Vice Chairman of the Atomic Industrial Forum, an association of business and academic interests concerned with the peaceful use of nuclear energy. I am a registered professional engineer in the State of Illinois, a Fellow in the Institute of Electrical and Electronic Engineers, and a member of the National Academy of Engineering. On behalf of Commonwealth Edison Company, we appreciate this opportunity to summarize our views on the critical need for energy research and development, and the role we see for the national laboratories.

The current oil glut is welcome news for the American motorist. Naturally, all of us are delighted to see gasoline prices coming down, even though relief may be temporary. However, there is a disturbing aspect to the current situation—lower prices are already encouraging consumption and fostering a sense of complacency about our future energy supplies. Unfortunately, the public's memory of oil shortages and soaring prices is short; and its support for long-term solutions seems to be waning.

Those of us with responsibilities for providing future energy supplies have good reason to be concerned about this trend in public attitudes. The danger is that given the need to curtail federal expenditures, the mistaken judgment could be made that the nation can afford to seriously curtail or even abandon the important energy-related research and development now under way at our national laboratories, including Argonne. If this were to happen, the relatively modest near-term savings would eventually have to be paid in the form of higher prices, larger energy supply risks, and greater environmental impacts for decades.

As your Committee is well aware, there is no shortage of energy resources now, nor is there likely to be in the foreseeable future. There are plentiful supplies of solid fuels: coal and uranium. The irony is that while these fuels represent about 80 percent of our domestic resources, they account for only about 24 percent of our end use. Because relatively scarce petroleum based fuels, oil and natural gas, were cheap and easier to use, they have been favored over the solid fuels, even though we are now forced to import huge quantities of costly foreign oil.

As a nation, we have already paid too high a price, both domestically and internationally, for our failures to adequately utilize domestic energy resources. On a matter as important as energy supply, America needs a high-confidence strategy—one that calls for shifting energy production toward plentiful domestic resources and away from expensive and unreliable foreign petroleum supplies, while encouraging more efficient energy use and conservation. The success of this strategy will depend upon an increasing number of better-educated scientists and engineers and a continuing flow of new knowledge from energy research and development.

I offer these observations, not to dampen the public's enthusiasm over lower gasoline prices, but to urge that, as a nation, we not lose sight of what must be done to ensure an energy-secure future. Smiling motorists filling up with lower-cost gasoline make great television footage. But although seldom seen on TV, the significant energy story has been taking place right here at Argonne.

For over three decades Argonne has been a center of scientific and technical excellence in energy-related fields. It has been a major factor in the development, in particular, of nuclear power, which currently accounts for 12 percent of all U.S. electric power generation and 45 percent of the electricity produced here in the Chicago area. In fact, last year Edison's six large nuclear units saved our customers about $500 million in fuel costs compared with low-sulfur coal—almost $2 billion if oil had been used instead.

Argonne's past contributions to the nation's economy include:

Development of the boiling water reactor concept and confirmation of the safety characteristics of light water reactors with programs like the Experimental Boiling Water Reactor, the BORAX, and the TREAT metal-water reaction experiments.

Assessment of the biological and medical effects of low-level radiation as the basis for international occupational standards.

Development of modeling techniques to study the effects of air pollution.

Evaluation of strip mine land reclamation practices which led to better and cheaper land reclamation methods.

A resource of technical excellence for government policy makers and regulators, as well as for universities and visiting scientists throughout the world.

A training ground for scientists and engineers engaged in the development, design, construction, and operation of new and improved energy systems, as well as for the teachers who are training new energy engineers.

No one can argue with the fact that the nation is in serious economic difficulty and that the time has come for the Administration and Congress to reassess national priorities in light of current realities, including the matter of energy research and development funding.

Although government support of energy R&D is a budgetary matter, it would be a serious mistake for Congress to assume that the current oil glut will solve our long-term energy problems. As a matter of public policy, we believe the nation simply must maintain a vigorous and consistent commitment to energy R&D in order to assure adequate supplies of reasonably priced energy in the future. This is critical to our economy, national security and, indeed, our way of life. Past R&D expenditures have paid large dividends. To cut back our commitments at a time when other industrial countries are investing in substantial long-term energy R&D will only lead to more severe problems for us in the future.

The questions for Congress to consider are how to allocate the energy R&D task between the government and private sectors, and what should be the level and character of ongoing government support.

We believe industry should continue to take the lead on product-related R&D, but that government must sponsor the bulk of the long-term generic R&D in order to ensure that it is given adequate attention. It would be unrealistic for Congress to look for industry to assume responsibility for this end of the R&D spectrum. The costs and risks are more than industry can handle. What is more, the prospects for paycheck from this type of R&D are simply too uncertain and remote to attract the necessary level of funding from the private sector. Long-term generic energy R&D is clearly a job for the national labs. There is also a need to maintain the national labs as centers of technical and scientific excellence to serve as a resource for government policymakers and regulators, and as an adjunct to our system of higher education. All of these are roles that only the national labs can fill.

Argonne has been successfully fulfilling these roles for many years, and continues to do so today. Ongoing Argonne programs which could profoundly affect the U.S. energy picture in the future include:

The magnetohydrodynamics (MHD) program that could eventually improve the efficiency and environmental acceptability of coal-fired electric generating plants;

Conservation and load management programs such as long-term ice storage for cooling applications which use energy efficiently, and will slow the need to build new power plants;

R&D aimed at developing a high performance battery which would make the electric car a practical alternative and thus allow a major shift to our abundant fuels and away from foreign oil;

Fusion programs that may eventually develop a new way to generate electricity using sea water as the fuel source;

Fast breeder reactor development programs that will improve the efficiency of fuel usage in nuclear reactors by 30 to 60 times current efficiency;

Light water reactor programs that are improving the safety of current generation nuclear reactors and developing better materials for use in newer reactors; and

Studies on the effects of burning coal, such as acid rain and carbon dioxide, that could eventually lead to changes in coal burning technology to make it more environmentally benign.

Not only is Argonne contributing significantly to R&D, but it is also providing support to the Nuclear Regulatory Commission (NRC) and the U.S. Environmental Protection Agency (EPA) by adding considerably to the knowledge and ability of regulators to oversee various energy industries. For example, Argonne has provided major support for NRC environmental impact statements and safety reports on nuclear plants, and has helped the EPA in the area of air quality regulation through its work on the burning of coal.

Argonne is a center of technical excellence where many scientists and engineers consult and train. Promising students and university faculty come to Argonne for advanced training. Industry consults with Argonne on issues at the forefront of current technology and legislators use the laboratory to obtain information needed for policy decisions. Indeed, laboratories like Argonne are an essential cornerstone of America's energy policy. They represent a significant national asset in terms of facilities and trained personnel that would be difficult if not impossible to replace in today's economic environment.

Time does not permit to cover more than a few reasons why we believe it is essential that the government continue to adequately fund Argonne and other national laboratories. Government funding of national laboratories benefits all citizens in many ways. There is no doubt that it is money well spent—in fact, it will yield important future dividends for us and our children. Without the generic long-term R&D which is done so well by Argonne and the other national laboratories, future generations would be committed to less secure energy supplies; supplies which may carry higher costs and more adverse environmental impacts.

Thank you for allowing me to express our views on this matter.

Senator PERCY. We'll go on now, to Mr. Joe Spivey, who is president of the Illinois Coal Association.

Joe, you and I have been working together, very fruitfully and productively, for many years. We've been working hard to increase exports of Illinois-basin coal overseas, with some very promising results. Governor Thompson and I consider ourselves salesmen for the industry, because it does create jobs. And, one of the best ways we can develop and expand the economy of southern Illinois, as well as strengthen the national economy and our national security. We look forward to your statement.

TESTIMONY OF JOSEPH S. SPIVEY, PRESIDENT, ILLINOIS COAL ASSOCIATION

Mr. SPIVEY. Thank you, Senator Percy. I'm most pleased to be here today, and I'll make my statement very brief. It is a summary of the overall statement which I've prepared for the record.

The Illinois Coal Association represents roughly 98 percent of the coal produced in the State of Illinois, which has been termed at, roughly, 60 million tons annually. As many of you here today are well aware, our single biggest problem over the past 10 years, is that we have been virtually a no-growth industry. The problem there, of course, is high sulfur coal. In fact, it has been, more or less, a way of life which we have come to recognize until recent times. The time here today is very short, so I won't belabor these points. I will touch briefly on several singular points affecting the future of Illinois coal, and some of them will be relevant to the problems I have just mentioned.

First, 1981 was the first year that Illinois coal left the North American Government for foreign shores to any great extent. For instance, most of you know about the sale of the cement industry in Spain. Even though small in quantity, it was a beginning, and I'm very pleased and most proud to say that Senator Percy had a lot to do with that sale, and that he has promoted the use of Illinois coal abroad, perhaps more than anyone in recent memory or times. He has worked very diligently in that area, and, Senator, on behalf of the entire coal industry, I do want to thank you publicly for that hard work and the efforts that you have put forth.

Another individual that has also stimulated public activities in the State of Illinois is Governor Thompson, and I think most of you can get that feeling from his presence here today. He has moved very boldly, over the past few years, with his administration, to permit the use of Illinois coal. And, I might also add, both Senator Percy and Governor Thompson have stressed that we do this with an environmentally acceptable manner and not at the detriment of the environment.

Most of us note, to some degree, that research has taken place at Argonne in the past, but even I must admit, I have not been completely aware of the activities until this year. Argonne, for example, has been very active in several areas of research for coal. We witnessed, this morning, the dedication of the dry-sulfur unit, which we think has a lot of merit, and will, indeed, have a big role for both small and large industrial users. We're also impressed—very impressed—with the fluidized bed combustion facility here. Also, Argonne's people are some of the best, professionally, that I have personally been acquainted with. They are also involved in reclamation activities, which you have heard about today.

We are deeply concerned, however, as most all of us are that because of budget constraints and the pressing economic problems that are facing our country, that such worthwhile projects as those underway here at Argonne may be pushed somewhat aside, and I think that would be a terrible mistake. The key word for us, in our industry, is research; our future truly depends on research. Coal has a potential far beyond that of a fossil fuel burned in a boiler and, with the help and the encouragement from individuals like Senator Percy, we are most encouraged. And, again, I thank you, here at Argonne, for the excellent work and effort that you've put into research on behalf of coal. Thank you.

Senator PERCY. Thank you very much.

Mr. Spivey, just one question. Why, in your judgment, is Argonne research into the use of Illinois coal so important to the Nation? And, could you answer the question that, while the private sector should do all its research, is it really feasible for this kind of research to be done by individual companies? Could you react to responses on that subject by Secretary Baldridge and Dr. Trivelpiece earlier today?

Mr. SPIVEY. I'd be most pleased to.

First of all, up until most recent times, the coal industry has been the producer—it has been reluctant to get into the area of research. We have, and I'm proud to say, that we are spending, not millions, but, in some cases, billions across the Nation in private research. When you get into the area of large-scale research for such a natural resource that we have in abundance, as coal, you are talking about extremely large amounts of money—much more money than can be raised by one individual, or several companies. For that reason, Government does have a role to play—a major role to play. We are siting, truly, on the "Saudi Arabia" of coal, and we need to be out of this bondage. In order to do that, we have to have the research, and, in order to do that, we must have Government playing its part as industry moves forward as well. It has been most unfortunate that the high-sulfur fuel research budget area has been cut severely. We hope that can be corrected to some degree. We're not asking for the moon, we're simply asking for some of the basic things that we believe must be carried forward.

Senator **Percy**. Thank you very much.

[Mr. Spivey's prepared statement follows:]

Prepared Statement of Joseph S. Spivey

Good morning—My name is Joseph S. Spivey and I am President of the Illinois Coal Association. I am pleased about the invitation to participate in this important hearing today.

The Illinois Coal Association is the trade organization representing those companies producing coal within the state of Illinois. The ICA member companies produce approximately 98 percent of all the coal produced in Illinois—or roughly 60 million tons annually.

Illinois is truly blessed with abundant natural resources—especially coal. The Illinois Coal Basin is often referred to as the "Saudi Arabia" of coal. The U.S. and Illinois Geological Surveys have estimated total known coal reserves within this basin to be more than 162 billion tons. Of that total, approximately 35 billion tons are easily recoverable by present mining methods. Technology in coal extraction in recent years has given this industry the ability to recover those seams of coal that just a few years ago would have been impossible.

We have in Illinois the existing mining capacity to produce an additional 12 to 15 million tons annually. This is without any additional new mines. The Illinois coal industry, for the most part, has been virtually a no-growth industry over the past decade. This is primarily because Illinois coal is very high in sulfur. The utility industry, which is the largest consumer of Illinois coal, had to make some rather difficult choices during the early seventies. The Federal Clean Air Act standards brought about major "market displacement" for Illinois coal. For example, in the early 1970s Commonwealth Edison was the single largest consumer of Illinois coal. Today, that company is importing roughly 15 million tons annually from states such as Wyoming. Illinois coal producers, on the other hand, were fortunate to find markets in other areas of the country for their product—in areas where air pollution standards were not quite so stringent.

Now, with these very brief facts in mind, I would like to tell you how we see the future for Illinois coal.

First, 1981 was the first year that Illinois coal left the North American continent for foreign shores to any great extent. For instance, most of you know about the sale to the cement industry in Spain. Even though small in quantity it was a beginning. Senator Percy has perhaps done more than anyone to bring about potential customers, public and private, for the export of Illinois coal. We are extremely pleased by his efforts and would also like to say that perhaps he, more than anyone, has brought new optimism and encouragement to our industry on the possibilities of exporting Illinois coal.

Secondly, on the domestic front, we are very fortunate to have an Administration in Illinois which has brought coal to the forefront. Governor Thompson and his staff have done more to bring about the use of Illinois coal than any previous Administration in recent memory. We are extremely pleased with his efforts and we know the Governor is sincere in his commitment in continuing the promotion of Illinois coal.

We are still searching for the "technology" that will make the use of Illinois coal environmentally more acceptable, thus leading to more high-sulfur coal usage. The key word surrounding the future of Illinois coal is "research." Though we are encouraged, we believe that there is much, much more that must be done to break us out of this bondage in order that Illinois coal can be more readily used.

There are several research facilities, public and private, that are working very diligently to accomplish ways of using Illinois coal more effectively. One such facility is right here at Argonne National Laboratory. The new experimental flue gas desulfurization unit or dry scrubber operation appears to hold much promise and, hopefully, will be a major breakthrough for our industry. Also, I am impressed with the fluidized bed combustion facility, which is under way as well. Both of the above technologies could prove to be most beneficial to large and small coal users.

Though Illinois has become, especially in most recent years, the leader in coal surface mine reclamation, we still need additional experimental and research data in some areas. Argonne is also involved in seeking such data with its present reclamation programs, carried out in concert with some of our companies here in Illinois.

Argonne's professional people are to be congratulated for the excellent work that they have accomplished. The work here is paving the way for a better future.

We are deeply concerned, however, that because of budget constraints and pressing economic problems facing our country such worthwhile research may be pushed aside without a full understanding of the impact this would have on our future. We will continue, as we have in the past, to work vigorously to save our most vital programs for research, such as those under way here at Argonne.

Thank you.

Senator PERCY. Our final witness is Dr. Robert Pry, director of research and development of Gould, Inc., of Rolling Meadows, a great Illinois company, under a tremendously dynamic and imaginative leader—one of industry's greatest, I think, in America today. And, under Bill Ylvisaker's leadership, Gould has become one of the most successful and profitable high-tech firms in the Nation. It could certainly offer a model and inspiration for many other organizations.

Dr. Pry, you have played a major role in making Gould a success. You also give us a national prospective, as a member of the DOE Energy Research Advisory Board panel, studying the future of the national laboratories. So, it's very appropriate that you be the anchor witness now in this particularly distinguished panel.

TESTIMONY OF ROBERT PRY, EXECUTIVE VICE PRESIDENT, RESEARCH AND DEVELOPMENT, GOULD INC., ROLLING MEADOWS, ILL.

Mr. PRY. Thank you, Senator. I'm glad you haven't lost your touch at keeping the best for last. [Laughter.]

Our company and I regularly take positions, both in support of our business and on important issues relevant to the national interest. These issues range from capital formation to energy self-sufficiency. This latter most important issue has recently receded from public attention. Since the combined forces of economic recession and conservation have dampened world oil demand. Nonetheless, diligence in finding alternative energy sources and more efficient use of energy is still a great national importance. The current lull in oil price increases will not continue indefinitely. We, too, prefer to leave as much development to the private sector as possible. However, some development is so long term and so risky that private investment is not forthcoming. Where vital national interests are at stake, such developments must be supported by the Federal Government. Reduced U.S. dependence on imported oil must be viewed as a goal of national security, and not just economic convenience. Much of our current expenditures by the Defense Department are directed toward securing resources of Middle East oil and oil shipping lanes. Obviously, a reduction in foreign oil needs could significantly lessen our military concerns in that region of the world. Some progress has been made, but there's a long way to go.

Development of coal as a clean fuel can not only lead to reduced U.S. oil needs, but can also make U.S. coal an attractive option to other oil-dependent nations. Furthermore, the developed cleanup or conversion technologies themselves can be a source of increased export.

Nuclear energy, so promising, particularly in Illinois, has had its safety, cost, and waste disposal problems. Federally funded research can help alleviate those problems, and provide for a more viable nuclear future. Argonne has been a focus of these efforts.

The impact of these technologies also needs to be evaluated. The national laboratories have played a critical role in technology development and impact assessment. Such large regional centers are necessary in order to incorporate the critical intellectual mass needed for major interdisciplinary research, development and analytical efforts. Argonne has become such a resource.

In the Midwest, for example, there are abundant coal reserves—but high in sulful content and almost all strip mined. Desulfurization of the region's coal is necessary for it to be competitive with low-sulfur, western coal. Such technologies have been studied at Argonne.

Much of the acid rain problem in the Northeastern United States and Canada has been ascribed to midwestern sulfur missions. We must better characterize the extent of the problem caused by midwestern industry and utilities—Argonne has been involved in that effort.

The agricultural departments of midwestern universities have been investigating strip mining reclamation. The focal point for such efforts, so germane to the Midwest, has been Argonne.

Argonne laboratories, with its multidisciplinary science base, has great potential for contributing to high-technology entrepreneurial activities, so vital for the growth of economy and jobs in this region. If one examines the reason for the rapid growth and affluence associated with words like Silicon Valley and Route 128, one central reason is the existence of a stable, ongoing, federally funded science program. Illinois, in particular, is awakening to these opportunities, and studies are underway to take action, at the State and local level, to promote high-technology opportunity. An important part of this thrust is a healthy, cooperative, Argonne science program. Thank you, Senator.

Senator PERCY. Thank you, Dr. Pry, very much. [Applause.]

Dr. Pry, after hearing all of the testimony today, about Argonne and the other national laboratories, does it reaffirm your belief that we should have a national commitment to adequate financial support for labs like Argonne? And, how can we give our labs more stability so their employees will have a greater sense of security?

Mr. PRY. All of us, in industry, who have a number of laboratories to account for, recognize the importance of stability and the appropriateness of adjusting programs. Sometimes these are conflicting interests. At the same time, if one recognizes the talent where it exists, you'd soon come to understand that the reduction of a program does not necessarily mean the reduction of people in that particular region where that program was conducted. It is also possible to shift some programs from other laboratories and to make those adjustments in such a way that one laboratory is not going up by 20 percent, while another is going down by 20 percent. That's a normal thing you take care of in industry, and I'm sure that our friends from DOE, this morning, will also, with your guidance, find such a solution. [Applause.]

Senator PERCY. I would like to make an announcement before you leave the table: It's been an important thing that Mac Baldrige and Dr. Trivelpiece left here and had to work their way through the crowd. It is standing room only, and what I've said, and staff confirms to me, the largest hearing group of guests we've had at any time in the history of the Governmental Affairs Committee of the U.S. Senate.

I do think, however, that we've had a few chairs open up with people who've had to leave. And, I'd like very much for the final panel, where we have the four directors of the midwestern laboratories testifying, for the 25 minutes that we have left, that everyone who is standing and have been so patient to stand there for 3 hours, find a chair. Here's a chair right next to me, one of you, please take it. There are chairs at the press table. If you are sitting next to an empty seat, will you raise your hand now so that they can just—come on now. Let's sit down, relax, and enjoy your last half hour, and just let those tired legs of yours rest. Gentlemen, thank you very much.

We're happy to now call our final panel, Dr. Massey, Dr. Lederman, Dr. Hansen, Dr. Edgington.

We still have a few empty seats over here if those of you, way in the back can just work your way down. There are still hands being raised.

Now, this final panel of the directors of the four midwestern laboratories—and, I might say that I've done more work to convince directors of laboratories who were thinking of leaving. More work getting people to take over laboratories here, particularly at Fermi. After working so hard against Rhode Island, California, and everything, with Everett Dirksen, we finally got it here—we finally got those open-occupancy laws passed locally, and then we had trouble getting the director to come out and take the job—we really had to work on him. I have enjoyed meeting with so many of you. You do a marvelous job. And, we have invited these directors, because, to a greater or lesser extent, they all share the problem of attaining proper Federal funds and levels from the Federal Government. I can just testify to everyone in this room, that they have really worked as hard at this job as at any other aspect of the job. They really realize they have to. The buck stops there—they've really got to get out on that frontline and fight for money. They are down constantly. Certainly, our first witness, my good friend and very respected friend, Dr. Walter Massey, director of Argonne Laboratory, and I have met many times.

You're obviously affected, Walter, by an obviously effective way that you have presented, in the past, the case for Argonne. Your credentials are very impressive indeed. On the faculty of the University of Chicago, a member of the board of trustees at Brown University, Council of the American Physics Society, and on the board of directors of the American Association for the Advancement of Science. Dr. Massey, we look forward to your testimony.

TESTIMONY OF WALTER E. MASSEY, DIRECTOR, ARGONNE NATIONAL LABORATORY, ARGONNE, ILL.

Mr. MASSEY. Thank you very much, Senator Percy.

I've submitted a copy of my written testimony. And, in the interest of time and since so much has already been said about Argonne's programs, for which I'm very appreciative, I won't stick to that testimony. I'd just like to say a few words, and give the other laboratory directors some of the time that I might have taken up; since much of the audience is composed of people who know me and our programs fairly well.

First I want to say how much all of us at Argonne, and indeed, throughout Illinois and the Midwest, appreciate your holding these hearings, and how much we here at the laboratory particularly appreciate your choosing Argonne as the site to hold them. I think it's important for the kind of audience we can attract, and also, for the symbolism that will come from these hearings to have such hearings at a place with the history that Argonne has and the achievements that this laboratory has attained throughout its 35-year history.

The budgetary situation is not rosy for the laboratory. We've already sustained a number of cuts in the past year, and we may have to in the future. This will be a problem that we will have to deal with. However, I would not like for you to leave, the audience to leave, without knowing that there have also been some triumphs over this period, and how proud I am of our staff to make those advances and to continue to make them in spite of such uncertainties in funding and instabilities in the future directions of our funding programs.

One of the biggest triumphs we've had is exemplified by the splitring resinator, on your desk in front of you. This was the construction of a new, super-conducting linear accelerator—the Atlas project.

Another user facility we dedicated this year is an intense-pulsed neutron source, a unique, world-class research facility, useful in both basic research and in applied research. This kind of apparatus exemplifies the role of the labs as a place where both industrial and university scientists can come.

We also dedicated another facility, a high-voltage electron microscope—again, a unique, world-class facility. And, again, it is being used by both the industrial and the university communities.

So, it's true that we're facing problems. But, the thought I'd like to leave is that, in spite of these problems and challenges, I'm sure that, with the assistance of people like yourself, Governor Thompson, and the dedication of the staff, we intend to remain a strong, healthy laboratory. And, again, thank you for holding the hearings here.

Senator PERCY. Thank you very much indeed, Dr. Massey. [Applause.]

In addition to the ability to applaud, I like to bring a hearing out of Washington and here in Illinois, where we don't have to observe protocol. In 15 years, however, this is the first time we've ever had employees and guests join us here at the table. And, I'm delighted to say that Howard S. Marks, professional staff member, who helped put this together, and Bill Strauss, staff director of the subcommittee, have given up their chairs so that two Argonne employees could come up here. They've just given me a note, indicating that it is Richard Graczyk, who is a pipefitter in the plant—you know, as I've said, people don't just come here and drift away. He's been here for 15 years, except for 5 years that he was layed off. He lives in Dolton. So, he's here, knowing what it's going to mean to scientists and engineers if they're layed off—he's gone through it.

Miss Loutralle Crawford works in the personnel division. She'd have to process people that go out. She's worked here since—she's a new employee—1951 [laughter], and lives in Joliet. We're happy to have you up here with us. Thank you very much.

Dr. Massey, I thank you for that presentation. It's really still just absolutely—I cannot adjust myself to the thought of losing, at Argonne, top scientists who are working in such areas as energy conservation, which is the biggest return on investment that we could make and the greatest single step that we could take toward insuring our economy and the national security. Such things as fossil-fuel development, and even in the health-science areas. You just can't afford to lose these good people. One thing I find most troubling is that Argonne and the rest of the national labs seem to be at the mercy of the programmatic budget. That is, there's no overall direction of maintained funding at Argonne to keep the team together, which is terribly important. We keep a division in the army together—we're not going to keep drifting them in and out and reduce it to half-strength or something—we keep them together, as a unit, knowing that they might be called upon in an emergency. The same thing is true here. As programs and program managers change, your staff is placed at risk. I believe there should be an overall, national policy to maintain Argonne at a steady level of support.

Let's talk about Argonne's budget again, as we have so many times together. Could you describe, in some detail, how these projected costs will affect you? The projected cuts, that is. Could you provide as many details as possible, so I can be better prepared, in the weeks and months ahead, to fight these cutbacks both in committee and on the floor of the Senate? And, anything that you'd like to provide for the record, rather than now, we will keep the record open for that purpose.

Mr. Massey. Thank you very much. I, as you know, at this stage of the budget process, it's very difficult to assess the final affects that the President's budget will have on the laboratory, because of changes in Congress. I think I will submit, for the record, however, an analysis, which we have done which shows what the effects would be on the laboratory's programs if, indeed, these cuts are sustained. It will cause a significant reduction in programs at the laboratory, proportionate to the budget cuts if they were to go through. I should say that, at this time of the year, usually, the proposed budget is not highly correlated with the final budget cuts by Congress.

But, that relates to the other point you made, and that is, the uncertainty in the funding of the laboratories as institutions, which can cause as large a problem, in the long run, as the magnitude of cuts themselves. The laboratories, such as Argonne, are funded from several different sources. We have 19 different congressional appropriations, 49 different programs and 129 different levels across which we cannot transfer funding. So, the problems a laboratory, such as Argonne, faces, is trying to maintain institutional health when the direction and the guidance and the funding comes from particular programs. And, I hope this is one of the issues which will be given adequate attention as the agency is reorganized. That is: Where does the responsibility lie for the laboratories as an institution?

Senator **Percy**. Being just as objective as you possibly can, and taking into account the disappointment that you feel and share with me, that it would be, that we would face, if we do allow some of the research programs that we know are valuable and essential for this country to go by the boards. I have written a letter to Secretary Edwards, which I will insert into the record at this point—a copy of which I'll give to you—requesting that he consider transferring some of the unclassified research from the weapons labs—that's Lawrence-Livermore, Los Alamos, and Sandia—to the large civilian labs, which have been hit especially hard in this new budget.

[The letter referred to follows:]

U.S. Senate,
Committee on Governmental Affairs,
Subcommittee on Energy, Nuclear
Proliferation and Government Processes,
Washington, D.C. March 19, 1982.

Hon. James B. Edwards,
Secretary of Energy,
Washington, D.C.

Dear Mr. Secretary: As you know, I am concerned about the funding cuts at Argonne National Laboratory. According to my analysis, Argonne could lose $36.8 million in operating funds, in fiscal year 1983 a 17.7 percent reduction from the previous year, if these budget proposals are adopted. This means more than the elimination of some programs, it means that Argonne could suffer yet another loss of jobs. Scientific talent cannot be cut and added from year to year subject to the vagaries of the budget process. If we value the capabilities of our national labs, we have an obligation to assure some consistency in funding from year to year. The alternative is a demoralized scientific community that will be far less productive than before.

In order to assure that we maintain the "critical mass" of talent that Argonne needs even in this age of fiscal austerity, I ask you to consider transferring some of the unclassified programs from the large weapons labs—Lawrence Livermore, Los Alamos, and Sandia—to the large civilian labs like Argonne. The civilian labs have been especially hard hit by reduced budgets and the transition to a Research and Development policy emphasizing basic and defense research. I fear that we may significantly degrade their capabilities for the future if we are not sensitive to their needs in making the change to new funding levels and priorities. I know that you strongly support the work of the civilian labs. They are fully capable of carrying out many of the unclassified work now conducted at the weapons labs—in some cases, these programs actually originated at the civilian labs and were later transferred away.

I hope you will give careful consideration to redistributing some of our Research and Development work. We have a responsibility to assure that the civilian labs remain viable, creative centers for scientific research. The present funding levels and program cuts threaten the people who work at these labs—and the people are the true scientific resource at these labs. While we cannot turn genetic researchers into nuclear engineers overnight, I think these scientists are capable and flexible in several different areas. It is crucial that we keep this talent in the labs.

Thank you for your consideration.

Sincerely,

Charles H. Percy,
U.S. Senator.

Senator **Percy**. Labs like Argonne are fully capable of conducting some of the nondefense programs that are now out at the western labs. In some cases, these programs started right here. It just makes sense to me to spread the burden of fiscal austerity in changing programs among the whole scientific research community. I don't think my colleagues, Senator Alan Cranston, and Senator Hayakawa would necessarily agree with me on this. Would you agree though, as a scientist, objective as you are [laughter] or can be, that, overall, this really would make sense. Where, you have an area that is not hard hit in one part of the country, against an area very hard hit here. Does it make sense, then, to shift programs that can easily be accomplished here?

Mr. MASSEY. In the interest of time, I'll be brief; yes. [Laughter.]

Senator PERCY. That's the only answer you needed, and I wish we had more witnesses like you in Washington. When you call for a yes or no answer, they give you 500 words, and you never know whether it's yes or no at the end of it. [Laughter.]

[Dr. Massey's prepared statement follows:]

STATEMENT OF
DR. WALTER E. MASSEY
DIRECTOR, ARGONNE NATIONAL LABORATORY
AND PROFESSOR OF PHYSICS, UNIVERSITY OF CHICAGO
BEFORE THE
SUBCOMMITTEE ON ENERGY, NUCLEAR
PROLIFERATION AND GOVERNMENT PROCESSES
OF THE
COMMITTEE ON
GOVERNMENTAL AFFAIRS

UNITED STATES SENATE
March 22, 1982

Mr. Chairman, Members of the Subcommittee, distinguished guests and colleagues:

I am pleased to be invited to appear as a witness at this hearing on the future of Federally funded National Energy Laboratories in the Midwest. I am particularly pleased that you have chosen to hold these hearings at Argonne National Laboratory, and wish to welcome you, the Members of the Subcommittee, the witnesses and other guests present today.

Let me say a bit about myself to put my testimony in perspective. I have been associated with Argonne National Laboratory for some time - as a post-doctoral scientist from 1966-1968, and subsequently as a consultant to the Laboratory for about 10 years. However, I have been Director of the Laboratory for less than three years, so my experience in this role is not extensive. My view of the national laboratories is that of one who has spent most of his life in universities.

Your letter of invitation identified a primary element in meeting the future energy demands of the United States -- the critical need for long-term energy research and development. The national laboratories are certainly essential in this effort. The place of national Laboratories in the fabric of the nation's science and technology activities has been the subject of considerable study and debate starting even before their formation. Further, conclusions regarding appropriate roles for the national laboratories are strongly influenced by the technical and political milieu of the times. It is clear that the current views on this subject are the most pertinent. In that context, therefore, two topics are most important: the present role and functions of national laboratories, and the relation of national laboratories to universities and industry.

National Laboratories are mission-oriented in the broadest sense. Some pursue energy-related research and development, and others add to that mission the support of weapons development. All national laboratories pursue basic research to varying degrees, and most laboratories serve as custodians of major research facilities that are made available to the scientific community. Other functions that are performed by the national laboratories include quick response to the needs of Federal agencies, the centralized management of significant programs as in the role of "lead laboratory," and as unbiased participants in evaluation and assessment of technologies. Thus, national laboratories pursue a broad range of programs under the guidance and with the support of the parent agency. These programs are oriented to the priorities of the nation by the processes that define the support made available by that agency. The national laboratories function as the practical expression of these priorities, and the functions of the laboratories necessarily change as these priorities are changed. However, the debates over national laboratories are more intense when the relationships between national laboratories and the rest of the nation's scientific and technical enterprises are involved.

PRESENT ROLE OF ARGONNE NATIONAL LABORATORY

Within this context it is appropriate to ask, what is the particular role of Argonne National Laboratory.

The present role of Argonne is to apply its broad-based scientific and technical resources to the solutions of problems of energy supply, energy utilization, and related health and environmental protection. This mission is fulfilled through a broad range of activities, including work in the basic physical, chemical and biological sciences, applied energy technology development, and in environmental research and technological assessment.

In carrying out its mission, the lab has to work in a manner which is compatible with and complementary to other research and development institutions: universities, private industries and other national laboratories. The mission of the universities and the nature of private enterprises allow for this compatibility and complementarity with the national laboratories. There is a legitimate need and role for each type of institution. The primary mission of the university is education which uniquely distinguishes it from the other two types of organizations. Scholarly activities, including research, in universities has to be consonant with this educational mission. This implies that certain types of research are inappropriate to be carried out at universities. The profit motive of private industry distinguishes this sector from universities or national laboratories. Research and development activities undertaken by private industry should contribute sooner or later to profits; therefore, certain types of research and development, which may not be supported by the market at particular times, will not be carried out in the private sector.

Appropriate research and development work in the national laboratories has its own characteristics: (1) It is long-range, high risk, with high payoff potential, and the near-term economic payoff is minimal; thereby providing little incentive for private support. (2) It addresses questions which have national or international consequences such as large-scale health and environmental problems. (3) It requires the use of facilities either too large or too complex to be operated by a single university or industry, or sufficiently unique that Federal funding is appropriate. (4) It involves issues where the role of the Federal government is clearly defined, for example, national security and issues such as nuclear proliferation.

By adhering to these guidelines, Argonne bridges the gap between work done at universities and research carried out in private industry. These guidelines also support the complementary relationship among universities, private industries and the national laboratories. The educational mission of the university is enhanced through programs which bring university scientists and students to the laboratories to engage in research utilizing the unique facilities. Special workshops, summer programs, and visiting sabbatical leave programs are other means through which the laboratories contribute to the educational and research goals of the universities.

The relationship between the laboratories and private industry is exemplified through programs of technology transfer. Technology transfer is a major responsibility of Argonne. This has been recognized in legislation, through direction from the Department of Energy, and by the establishment within the Laboratory of an organization with specific responsibility for the management and coordination of technology transfer efforts. Further, an integrated approach involving participation in national activities with other organizations is also taking place. The Industrial Research Institute and the Federal Laboratory Consortium are two such organizations. The Laboratory is also increasing its cooperation and involvement with local and regional organizations, both industrial and governmental, through sponsoring seminars, joint research efforts, and through faculty student and scientist exchange programs.

FORMATION AND HISTORY

Before I speak about the specific research and development programs now existing at Argonne, it may be useful and informative to review briefly the historical development of the laboratory.

Argonne National Laboratory was the first of the Manhattan Project laboratories to be designated a "national laboratory." With the outstanding accomplishments of the World War II Manhattan Project as visible evidence of the strength of Federally funded research laboratories, a committee of midwestern scientists was appointed to formulate plans and policies for a permanent laboratory to continue the work started on the campus of The University of Chicago. As a result of this committee's work, Argonne National Laboratory was established in 1946 as a government-owned research facility to be operated by a private contractor, The University of Chicago.

This new laboratory was conceived primarily as a research organization with its program centered on the basic scientific study of phenomena expected to be important to the development of nuclear energy. This basic research work was in the physical and chemical sciences as well as in biological and medical areas. A major broadening of this role occurred in 1948 when the newly formed Atomic Energy Commission (AEC) requested Argonne to assume key responsibilities in the field of reactor development.

Since that time Argonne has had a primary mission to develop the peaceful use of nuclear power, particularly for central station electrical generation. All of the main nuclear power systems now in worldwide use, or expected to be in use in the future--the pressurized light water reactor, the boiling light water reactor, and the liquid metal fast breeder reactor--had their origins or major developments at Argonne.

The many outstanding accomplishments of the program include the etablishment of the feasibility of the boiling water reactor concept with the Experimental Boiling Water Reactor (EBWR). The first nuclear generation of electricity by the Experimental Breeder Reactor at Idaho in 1951 stands out as a major landmark. Its successor, the Experimental Breeder Reactor-II (EBR-II), has many of the features characteristic of a large commercial sized fast breeder power plant, even though it is of much smaller size. EBR-II has developed a remarkable record for plant availability since its dedication in 1964, and remains today a key resource of the Argonne reactor program.

From the initiation of the reactor program until the mid-1960s, the Argonne effort was about equally divided between development of the light water reactor and development of the fast breeder reactor. In the mid-1960s, the character of the Argonne Reactor Development program changed when the U.S. made the decision that the government would step out of the development phase of the light water reactor. At that point, the primary focus of the Argonne program became the development of the fast breeder reactor and remains so to this time.

During the early 1950's, the basic research activities at the Laboratory grew in stature and scope; the growth of facilities and equipment matched the expansion of the research efforts. A major event of this period was the occupation of the permanent site for the Laboratory in Du Page County, some 20 miles southwest of Chicago. With the completion and occupation of the major science buildings on this site, Argonne became one of the foremost research institutions in the world.

The success of the laboratory reactor development led to the establishment of Argonne-West, on the Idaho National Engineering Laboratory site outside of Idaho Falls. Argonne-West, an integral part of the Laboratory, now has over 700 staff and is the site of the lab's major experimental nuclear facilities, including EBR-II.

In 1956 the AEC requested Argonne to design a high energy physics research facility based on a 10-15 GeV weak-focusing synchrotron. This led to the buildup at Argonne of a strong team of high energy accelerator scientists and engineers and to Congressional authorization for the construction of the Zero Gradient Synchrotron (ZGS) in 1957.

This high energy physics program marked the beginning of a new era for Argonne; it accelerated the change in the Laboratory's character from being mostly an inhouse AEC resource to a user-oriented laboratory. This user-orientation had an exceedingly important regional component. The ZGS was the first high energy accelerator in the midwest and thus offered an outstanding opportunity for building strong new physics research groups in midwest universities.

The ZGS remained the most powerful particle accelerator in the midwest until the opening of Fermilab in 1967. No doubt a significant factor in persuading the Federal Government and the high-energy physics community to locate Fermilab in this region was the strong base of research in the universities which had to a large degree been fostered by the presence of the ZGS at Argonne.

Another long-term effect of the new ZGS accelerator program was the development at Argonne of frontier expertise in a number of new areas of technology such as magnets and applied cryogenics, high power radio frequency systems, and applied superconductivity.

The vital interests of the university community in the research facilities at Argonne were recognized with the organization of the Argonne Universities Association (AUA) in 1965. Shortly thereafter (1966) a new, tripartite contract for the direction, operation and management of Argonne was signed by the AEC, The University of Chicago, and AUA. This arrangement was designed to encourage cooperation within the midwestern community for the stimulation of scientific and engineering research and development, and to facilitate mutually beneficial interactions between the Argonne staff and the university and industrial communities.

The spectrum of Argonne's work activity was expanded during the 1970's as the potential for non-nuclear energy sources and their various environmental effects became matters of intense public interest. The replacement of the Atomic Energy Commission by the Energy Research and Development Administration in 1975, and its subsequent replacement by the Department of Energy (DOE) in 1977, were effects in the political sphere of this awakening public interest. New kinds of energy research and development work were begun at Argonne in support of the additional technical programs for which DOE has federal responsibility.

CURRENT ARGONNE PROGRAMS

Let me now say a few words about the present activities at the lab. At this time Argonne is organized into four functional areas, each headed by an Associate Laboratory Director. These are: Biomedical and Environmental Research, Energy and Environmental Technology, Physical Research, and Reactor Research and Development. These areas are further subdivided into divisions, some of which are organized around functional needs. (An organizational chart is appended.)

All of the divisions at the Laboratory are subject to an annual peer review, each performed by a committee of outside reviewers from academic institutions and relevant industries. These reviews, directed to the Laboratory contractors - the Argonne Universities Association and the University of Chicago - provide an independent assessment of the performance and quality of the staff and the relevance of their work. In addition, Argonne management makes use of an annual strategic plan developed by each division for a five-year period, to ensure that the work of each division is in harmony with the overall missions of the Laboratory. The strategic planning process provides a logical input to the Institutional Plan which is a key mechanism by which the Laboratory documents the program direction and agreements with the Department of Energy.

The Physical Research Program

Physical Research at Argonne is the organizational locus for a broad spectrum of largely fundamental research for the operation of major, often unique facilities utilized by Argonne scientists as well as a large number of university, industrial laboratory, and national laboratory scientists; and for the pioneering research and technical innovation responsible for many of the major facilities systems now at or being developed by Argonne and others which are projected for the future.

This program encompasses a wide spectrum of research activities, including high energy, atomic, and nuclear physics; materials sciences; chemical sciences; and applied mathematics. The work is carried out in seven major scientific divisions. In addition, the Physical Research program assists outside users of its major user facilities, an activity recognized as one of its primary responsibilities. These facilities are the foci of large multidisciplinary Argonne research programs. The most prominent such facility now is the Intense Pulsed Neutron Source (IPNS), a world-class spallation neutron source conceived and constructed at Argonne primarily for studying the properties and structures of condensed matter as well as irradiation effects. Because IPNS provides a pulsed spectrum of neutron energies differing sharply from that of a nuclear reactor, it affords opportunities for investigations heretofore impossible. To exploit these opportunities, new types of instrumentation had to be developed; much of this was done at Argonne. IPNS and this state-of-the-art instrumentation are now in operation and will be used by a broad spectrum of the American scientific community.

Other major user facilities include the High Voltage Electron Microscope-Tandem Accelerator facility (HVEM) and the currently-under-construction Argonne Tandem-Linear Accelerator System (ATLAS). The HVEM can be used to follow real-time structural changes in materials subjected to ionic bombardment at a resolution close to the atomic level. ATLAS, when completed, will be a national facility with unique capabilities for high-precision nuclear research with heavy ions.

In the Physical Research program, scientific excellence and importance of the work are the prime criteria for initiating and retaining a given research effort. Also, the Physical Research programs are designed to make effective use of the multidisciplinary nature of the Laboratory, its size and the resulting scope of activity, the availability of forefront research facilities, and extensive technical support services.

The Reactor Research and Development Program

The primary focus of the Argonne reactor program is the development of the liquid metal fast breeder reactor (LMFBR). This program had its start in the efforts that led first to EBR-I and then EBR-II. The operational experience and research programs associated with EBR-II still remain key parts of the program.

Along with the operation of EBR-II, fast breeder reactor technology has been the main focus of the Argonne LMFBR program. The main elements of breeder technology are Facilities, Physics, Safety, Large Components Development, Fuels and Materials, and Reprocessing. In the U.S. program, Argonne has a major fraction of the available facilities. In the Physics and Safety areas, we have the major parts of the U.S. program and are generally acknowledged as the world leader in these disciplines. In the Large Components Development area, we perform or direct 90% of the LMFBR program.

The reactor program at Argonne is now marked by an essentially complete set of required facilities that allows the continuing development of LMFBR technology. Located at Argonne-West in Idaho, in addition to EBR-II, is the Zero Power Plutonium Reactor (ZPPR) critical experiment facility, which allows mockup of full-sized commercial fast breeder reactor plants. Associated with this facility is an inventory of over 3,000 kg of plutonium and all of the other building block structural materials, including sodium, that are required to mock up accurately any required plant. Also at the Idaho site is the TREAT reactor which allows many key safety experiments to be performed. Bundles of prototypic fuel elements, both irradiated and non-irradiated, can be exposed to postulated accident conditions with observations made with unique diagnostic equipment that has been developed for these experiments. The TREAT reactor is now undergoing a major upgrade that will much increase its capability. Tests of larger fuel bundles at more prototypic test conditions will be possible after completion of the TREAT Upgrade project. A major facet of the safety program is the use of EBR-II to perform operational safety experiments. Such tests are not primarily concerned with issues of public safety but rather with normally expected transients and fuel failures. Also at Argonne-West is the Hot Fuel Examination Facility (HFEF), which allows the examination at both the macroscopic and microscopic level of fast reactor fuel elements. The elements examined by HFEF include those removed from EBR-II, and will eventually include those from the Fast Flux Test Facility at Hanford, and also those from the tests in the safety experiment program.

The Laboratory has also maintained an important program in light water reactor (LWR) technology. This work has been focused on materials technology, thermal-hydraulics, and engineering mechanics technology with a major emphasis on safety issues. Much of this LWR work is funded by the Nuclear Regulatory Commission.

The Energy and Environmental Technology Programs

In Energy and Environmental Technology programs, applied scientific and engineering disciplines aid the development of magnetic fusion, fossil energy, solar energy, and conservation technologies and the analysis of related public policies. Over the last decade, we have increased our involvement in these new areas of research. These increases were built on our earlier established strengths in basic research and nuclear fission, so the new areas are outgrowths of and complementary to the Laboratory's traditional strengths.

Our past involvement with technologies as varied as fusion, fossil, solar, and conservation reflects an appropriate role for the Federal government, a Federal role that can be viewed in two somewhat distinct categories. First, the Laboratory played a pioneering role in the discovery and early conceptual development of advanced technologies (examples include nuclear systems for magnetic fusion, fluidized-bed combustion, magnetohydrodynamics, high-temperature nonaqueous batteries and compound parabolic solar concentrators).

dioxide. Toxicological problems remain an important part of the future programs; quantification of low-level radiation effects will remain a challenging goal due to the widespread concern about radiation, and the potential health hazards from other energy sources will continue to be important problems for the Argonne life science program.

University-Industry Interactions

Earlier I briefly discussed the relation of the national laboratories to private industry and to universities. This topic deserves additional discussion. All the national labs have extensive involvement with universities. The single-purpose labs, such as Fermilab, operate facilities almost exclusively for the benefit of university users. The multi-program labs like Argonne and Ames have a broader spectrum of relationships with universities and industries.

Most of the multi-program laboratories have a unit devoted exclusively to nurturing, promoting and administering university-laboratory interactions. For example, at Argonne, the Division of Education Programs has this responsibility. The activities carried out by the Division are funded both from laboratory overhead and by direct programmatic funding from the Department of Energy. This is typical of all the laboratories.

The activities can be organized into four categories. The first is visiting or temporary appointments for both faculty and students. The number of people involved is substantial. In FY 1980, for example, Argonne had about 630 such appointments and in 1981, about 430. It would be difficult to overstate the value to both the laboratories and the university community of the stimulation that results from these appointments. Moreover, these appointments involve many of the best established and developing scientific and engineering minds in [illegible] in the efforts to solve the energy problem. Research participation and thesis research opportunities are crucial elements in the nation's effort to assure the availability of trained manpower for this task in future years.

The second major category of laboratory-university interaction involves the use of facilities by faculty and students. We have about a dozen such facilities at Argonne, and in FY 1980 had over 80 user groups carrying out experiments on them. As I said earlier we recently began operation of a new user facility, the Intensed Pulsed Neutron Source, and there is a great deal of interest in it in the academic community. We have many more proposals for experimental work on this device than we can handle, far in excess of what we could accommodate if we could run the device 24 hours a day all year.

We also serve as host to a large number of university faculty at conferences, short courses, workshops, and seminars. During FY 1980 over 2400 faculty members came to Argonne for such events lasting from a day to a full week; the figure for 1981 was about 1400. These activities are designed to provide the participants with complete information on the latest developments in their respective fields. This is, of course, a very important mode of scientific exchange.

Second, the Laboratory provided vital applied scientific and engineering support to emerging and new commercial energy technologies. Such support addressed generic problems in materials, instrumentation and control, and component design that are applicable to a wide range of technologies. These generic technology programs represent a highly cost-effective role for the Federal government in support of billion-dollar investments in new technology by the private sector. In all of these programs, an important Laboratory role is to prepare and disseminate technically accurate and objective information to both the public and private sectors.

The Biomedical and Environmental Research Program

Biological and Environmental Research at Argonne has a multidisciplinary, long-term, generic nature, although a few of the studies are technology-specific and provide timely short-term information. The programs range from basic mechanistic studies at the molecular level to applied assay system development; from studies of primary physical and chemical interactions on extremely short time scales to long-term determinations of chronic biological and environmental effects. The scope of agents studied is comparably broad and includes a variety of nuclear and non-nuclear pollutants, including alpha emitters, gamma rays, neutrons and non-ionizing radiations, toxic metals and organic chemical compounds. Pollutants are identified, characterized, and monitored, and their transport mechanisms and fate are elucidated.

This program is primarily carried out in three major scientific divisions, although portions of the work have been placed in several additional divisions. Unique research facilities, such as the JANUS reactor, gamma-ray exposure rooms, and a 58-foot research vessel are some of the noteworthy scientific assets of these programs.

The life sciences program at Argonne has been designed to be an integral part of the basic energy related missions of this Laboratory. As new energy technologies emerge, the health and environmental consequences of their effluents must be investigated in order that the relative risks inherent in each are clearly understood. Such investigations are of most value when they are pursued concurrently with the development of the technology, so that the development does not become irreversibly committed to one process only to learn too late that an alternative process produced fewer environmental or health effects. Thus, the health and environmental program is most effective when it is conducted as a partner in the technology development program. This has been the function of the biomedical and environmental program at Argonne since its inception.

The current program has evolved in a natural fashion from its earliest mission, the quantification and evaluation of the risk to nuclear workers from exposure to nuclear radiations. The evaluation of the environmental consequences of major energy production systems was a later addition to the original radiation toxicity mission. Many of the future program areas of importance reflect the growing awareness in this country of the need for an understanding of the environmental consequences of energy-related programs. Among these are an understanding of the effects of acid rain and the enhanced production of carbon

Finally, the national laboratories involve university scientists and engineers in research through formal contractual agreements. The amount subcontracted can vary significantly from year to year depending on circumstances. At Argonne it has been as high as seven million dollars a year. Last year it was over one million dollars.

These types of activities are strong indications of the success of the relationship that exists between universities and Argonne National Laboratory.

Historically, none of the laboratories, including Argonne, have had the kind of broad-based relationships with private industry that they have had with the universities. There have been very strong interactions with particular industries, of which the nuclear industry is the most prominent. Since Argonne's major role historically has been in reactor research and development, there has always been a strong relationship between the reactor manufacturers, vendors, the utilities and the Laboratory.

However, as the work at the laboratories has diversified over the past decade, opportunities for strong relationships with a broader base of industrial firms have emerged. The relative newness of some of these activities has legitimately brought the question of industry-laboratory relationships under more scrutiny than that of university-laboratory relationships. The Department of Energy, recognizing that the laboratories constitute a tremendous resource for cooperative ventures with private industry which can be of mutual benefit to both, has moved to establish policies to encourage this. It is clear that the role of a national laboratory in relation to industry should be that of a source of information and ideas. The laboratories conduct research that expand an entire base of technology and perform engineering development on high-risk energy technologies. This research ought to be carried only to that point where technical and economic feasibility is demonstrated. The present Administration has established a policy that the role of the Federal government, including the national laboratories, in mounting large-scale demonstration projects ought to be minimal and should in no case go beyond the point where it is legitimate for private industry to be involved. There is of course no exact point where development ends and demonstration begins. But the principle is nevertheless valid.

There are several mechanisms by which the laboratories and industries cooperate jointly to carry out research and development. Let me mention a few of those used at Argonne.

Collaborative research activities are generally undertaken without formal agreements or a contract. Scientists from both institutions cooperate on research which is then published in the open literature. An example of this is the research that Argonne and the Mayo Clinic are doing with the Upjohn Company and Eli Lilly. The research utilizes two-dimensional electrophoresis instrumentation which was developed in the Biological and Medical Research Division at Argonne. There is also joint work between chemists at Argonne and at DuPont to carry out neutron diffraction studies of catalysts, and collaboration between scientists at Bell Laboratories and at Amoco and our solid state scientists to do x-ray and neutron diffraction studies of new organic superconductors. Examples of this type abound and are common at all of the laboratories.

A more formal type of arrangement is through industrial participation agreements. These are formal contracts, flexible in their terms, involving in most cases an individual or team from a private industry coming to the Laboratory to work for a few months to a year. The firm pays the complete cost or shares cost of the work with the Laboratory. These agreements have been used in all of Argonne's programs in both basic research and development activities. The Laboratory gains from the efforts and ideas of experienced industrial scientists and engineers. Industry gets first-hand experience and an opportunity to assess a developing technology not ready for the marketplace. The industrial participants go to their firms regularly to report on activities and then return to the Laboratory to continue the work.

We have had such agreements with a number of companies, including Exxon, Dow, Burns and Roe, Rockwell International, RCA, Babcock and Wilcox, and major battery manufacturers.

The Laboratory also interacts with industries through subcontracts for research and development. These subcontracts provide the development of a manufacturing and fabrication capability in industries and allow establishment of cost and technical feasibilities for research products which will emerge from the laboratory. Over the past few years, we have awarded subcontracts for the development of advanced batteries, solar collectors, components for nuclear reactors, and instrumentation for measuring and testing fossil energy plants.

Certain facilities at Argonne are of particular interest to industrial scientists and engineers and these are available for their use. These include the Intense Pulsed Neutron Source which provides high intensity neutrons for materials studies, which I mentioned earlier; and test reactors such as the Experimental Breeder Reactor-II, and the Transient Reactor Test Facility (TREAT).

Industrial users may use some of these facilities for proprietary work. In these instances the full cost for the use of the facility is paid. Typically, for universities and industries, there is no fee for facility use when the results are to be published in the open literature.

Still another kind of interaction I should mention is the exchange of information among industrial and laboratory scientists and engineers at meetings and conferences. In 1980, Argonne managed 24 meetings at which industrial representatives made up a substantial percentage of the 4700 visitors who attended.

One of the biggest obstacles to interaction with industries that we have found has been the lack of familiarity of industrial researchers with the laboratories. To remedy this situation a task force has been established which includes representatives from the Industrial Research Institute (IRI) and eight of the multiprogram DOE national laboratories. This IRI/National Laboratory Task Force has been in operation for about a year now. Its purpose is to foster more positive interaction and cooperation in R&D efforts between industry and the labs. Meetings have been held at Argonne, Oak Ridge, and Brookhaven. Some specific activities which the task force will carry out over the next several months include: developing a more formal means for communication and dissemination of information between the labs and research industries;

dissemination of information between the labs and research industries; involving industry in the planning and utilization of the facilities at the labs; and identifying positive models for interactions which might serve as examples to be emulated. In addition, the writing of a number of articles has been undertaken for journals that reach industry management. The first dealing with technology transfer, will appear in the May issue of the IRI journal, Research Management.

These activities involving industry are relatively new and have not yet borne fruit. They do not involve the numbers of people or the range of activities encompassed by university-laboratory relationships. However, I believe all the parties involved are encouraged by these beginnings.

These hearings are concerned in particular with the role and effectiveness of the laboratories in the midwest. In all the activities described, dealing both with universities and industry, there are strong ties to midwestern institutions and midwestern researchers. Furthermore, both the Governor of Illinois (Governor Thompson) and Mayor Byrne of Chicago (as she has testified) have recognized the importance of Argonne and Fermi in their efforts to attract and develop more technology-intensive industries in the area. I have been very pleased to serve as Chairman of Mayor Byrne's Task Force of High-Technology Development.

There are of course more direct and immediate economic contributions which both Argonne and Fermi make to the area. Argonne's payroll for FY 1981 totaled $138,720,000. Of our total procurements in the same year, $38,874,500 went to Illinois providers of goods and services. Procurements of $42,879,000 went to small business firms, and an additional $4,558,000 went to miniority business firms.

FUTURE OF ARGONNE NATIONAL LABORATORY

During the past several months, we have conducted an intense review of the research and development activities at Argonne. This review has been prompted by a number of factors which have affected the Laboratory and will affect it more in the future. The most important of these is the current reassessment of the structure and needs of the U.S. research and development establishment.

In looking to the immediate future the most challenging problem we face is to adjust to severe reductions in funding and consequently in scientific and technical staff. Our funding and manpower levels for several years are shown below.

Fiscal Year	Budget	Manpower
1980	$240.7 million	5,065
1981	$243.7 million	4,698
1982	$230.0 million	4,278
1983 (est.)	$178.5 million	3,427

In spite of these problems, we have, as I said, developed a plan for future R&D activities at the Lab. As we look to the future, the general outline of our role and responsibilities seems clear. The bulk of our activities will be focused on long-term, high-risk energy research and development projects which have been identified as national needs. A significant portion of our activities will be in basic research; a basic research component is necessary for any laboratory whose missions depend upon a strong scientific and technological base. In addition, a portion of its activities will be dedicated to the stewardship of Federally-funded facilities for the benefit of all users.

Overall, we have identified certain programmatic areas for which we clearly have the knowledge, staff expertise and desire to contribute, and which are obvious national needs. Most of these relate to energy. Nuclear fission programs focused largely but not exclusively on the breeder system constitute this Laboratory's first priority. Fusion systems are an important national goal; Argonne's expertise in appropriate technologies uniquely qualifies the Laboratory to serve the Nation's fusion energy program as it enters the engineering phase. Fossil energy sources, particularly advanced systems, pose major technical problems as the limits of materials are tested and new ways to extract energy are sought; our expertise is relevant here as well. The effective development of each of these technologies includes critical roles for materials science, instrument development, environmental evaluation and theoretical analysis.

It is part of the national laboratories' mission to construct and operate major research facilities which meet the needs of academic and industrial users as well as Laboratory staff members. Research tools such as the High Voltage Electron Microscope and the Intense Pulsed Neutron Source are part of the user-oriented function of Argonne that will be carried into the future. Funding now has been received for construction of another user facility, the Argonne Tandem-Linear Accelerator System, which will be a national facility for heavy ion research. It is possible that more user facilities will be placed at national laboratories in the future as the costs of advanced technological facilities increase in step with their complexity. We are currently developing a design proposal for a 2 GeV electron accelerator, and are planning for the design of an advanced neutron source. Both of these would be major user facilities.

The specific program areas on which we intend to focus our future efforts are identified and briefly described below.

The fast breeder reactor program is the major program at the Laboratory and will remain so until the breeder is ready for commercialization. The timetable for commercialization of the breeder reactor is uncertain, and it appears that industry will not develop the technology with private capital. Until the breeder is available as an energy supply option in the U.S., the major development effort must be Federally supported. Argonne is qualified, both in staff and facilities, to carry out development and provide continuity to the breeder reactor program. Our activities will center on the key areas of safety, licensing, physics, core design, and component development. This broad base of Argonne technical expertise in fast breeder reactor technology can best assure that progress in the base technology program is integrated into the industry-related design projects.

The light water reactor program will remain at the current level with emphasis on certain key areas, primarily focused on safety issues which are of current concern. For many years, we have pursued a small, but important program in light-water reactor technology. This work focused on various aspects of base materials technology, thermal-hydraulics, and engineering mechanics technology. The accident at Three Mile Island has heightened public and regulatory concern over accidents producing core damage and systems transients potentially leading to severe accidents. This has led to an increased effort by Argonne in the light water reactor area. Argonne is uniquely qualified to undertake these studies, because much of the effort is complementary to that underway on the liquid metal fast breeder reactors.

Argonne will participate in fuel cycle programs that are important to the utilization of fission reactors. The fission fuel cycle external to the reactor and its components has varied in importance depending on economic and political factors, but certain parts of the fuel cycle continue to warrant national attention. Development and testing of advanced reactor fuels is critical to the safe and economic performance of reactors, and we will continue to participate in this program. Fuel reprocessing research and development, particularly by advanced methods, has been a major capability at Argonne. Such methods will be applied to a variety of separations problems, and development of specialized techniques for reprocessing will continue. Solutions to radioactive waste management have become a necessity to the future utilization of fission (and fusion) power sources. We will continue to serve as a neutral, technically competent resource and also pursue waste-related research in focused areas.

Fusion technology development has the potential to become a major focus of the Laboratory in the future. Based on an extensive background in nuclear reactor design and analysis, we plan to focus on the engineering and technology aspects of fusion reactors, with emphasis on materials research, system design, components technology, tritium breeding technology, and superconducting magnet technology. Because fusion research involves complex and expensive state-of-the-art technology and because commercial applications are far in the future, it is an appropriate task for the national laboratories. We, therefore, consider that fusion technology research and development could become a major focus of our activities in the future, as the national fusion program enters the engineering phase.

An opportunity will develop during the engineering phase for the training of engineers for the fusion industry. We propose that such a program, complementary to university fusion programs, emphasizing hands-on experience building and operating fusion power plants, would be a natural role for those laboratories developing fusion power, and one it desires to initiate.

Basic research in the physical and life sciences will be a major component of the Argonne research and development effort. The problems addressed will be determined largely by the requirements of the Laboratory's missions and will be intended to provide an adequate scientific base for the technological programs of the Laboratory. In addition, this effort will make a significant contribution to science and human knowledge.

The scientific research program will address problems in physics, chemistry, materials science, and the life sciences. Many will be among the most complex for which there is reasonable hope of solution. The nature of these problems will require a collaborative effort by teams of scientists expert in many disciplines. Specialized research facilities and a high level of technical support by electronics, computer, and instrumentation experts will be characteristic. Because Argonne is an institution primarily devoted to scientific and engineering research and development, we have the organizational flexibility and the research support capabilities essential to undertake complex, interdisciplinary problems.

Materials science will be a major and growing area of research. The study of materials is an essential effort for all of the applied activities at the Laboratory: fission, fusion, work in the fossil area, solar and conservation. In many of these applied areas, improved materials are expected to be the key to achieving satisfactory technical and economic performance of new energy technologies. Materials research is the largest effort in our program of basic research and base technology. The High Voltage Electron Microscope and the Intense Pulsed Neutron Source are powerful new national user facilities for materials studies. Efforts in materials science will be strengthened and consolidated to make the most effective use of Argonne's unique research capabilities and facilities.

We also will carry out programs in the national trust areas of fundamental science such as nuclear physics and high energy physics. The emphasis of our nuclear physics program is moving toward heavy-ion and medium energy research. New superconducting accelerator technology has been developed and is being used for the construction of the Argonne Tandem Linear Accelerator System (ATLAS). This machine will be operated as a national facility for heavy ion research. The high energy physics program at Argonne now is centered on the design, construction and use of large-scale detector facilities for fundamental experiments on the elementary particles. These detectors are being constructed in close collaboration with university researchers. A new 2 GeV electron accelerator to be proposed as a national center for nuclear physics and particle physics experiments is now being designed.

Since its inception, Argonne has had a strong program in radiobiology, devoted to understanding and quantifying the risks associated with nuclear energy. From these efforts a research program evolved directed toward the health, safety, and environmental effects of effluents from alternate energy technologies. These activities will be maintained, as will the capability to perform environmental assessments, technology evaluations, and systems analyses, as required.

To summarize, the future is uncertain, but it is clear that for the foreseeable period, Argonne may be smaller but will be a sharply focused Laboratory. As we look to the future, our efforts will be focused as follows:

1. Base programs in nuclear power will constitute our major activities; a strong base in breeder reactor technology will continue, and a role in fusion engineering will be vigorously pursued.

2. Activities in other technologies will be in areas where the pay-off potential is greatest and where Argonne has specific capabilities. In addition, we will maintain the capability to plan, monitor, implement, and assess external or in-house activities as requested by the funding agency.

3. Basic research in physical and biological sciences is a necessary adjunct to the applied programs, and will remain a strong component of the Laboratory. Selection of basic programs will be made with care, imagination, and concern for their future potential. Materials research will constitute an area of increased strength.

4. High priority will be given to programs that will increase collaboration with university and industrial researchers in basic and applied research projects and their utilization of "user facilities." Participation by the university and industrial research community in the planning and proposal process is considered necessary to assure research optimization and will continue to be actively sought.

SUMMARY

I am very pleased to have had the opportunity to present this overview of Argonne's programs and our future plans to this Subcommittee. There are some additional issues which might be of particular interest to you. These are issues which transcend particular research and development programs.

1. The first concerns the relationship of the national laboratories to agencies other than the parent agency. This is a topic currently under review by the Energy Research Advisory Board's Panel of Multiprogram National Laboratories. At present approximately 11% of Argonne's funding is from agencies other than the Department of Energy.

We expect to continue to accept work from other agencies in order to perform our function as a national resource. The option that national laboratories be more available to perform work sponsored by industry is consistent with this national resource function. Argonne will not seek a role as a "job shop" in competition with private institutions. Rather we encourage positive policies and practices toward industry-sponsored work that is consistent with the Laboratory's mission and role, that would provide "synergistic" advancement of the research, or that would promote technology transfer. It is clear that the Laboratory as a national resource should provide needed "technical assistance" to a firm undertaking a new venture based on Argonne developed technology.

2. The second issue relates more specifically to the Lab's role in meeting the scientific and technical manpower needs of the country.

The training of scientists and engineers on which the future of our nation depends is primarily a responsibility of academic institutions, but the national laboratories have also played a strong complementary role. Both undergraduate and graduate students are intimately involved in many programs in these laboratories. With the support and encouragement of the Federal Government, these programs could be significantly increased. Argonne firmly supports and encourages appointments designed to enhance the experience of these students, and strongly supports visible efforts to increase the number of such opportunities currently available.

3. And finally, the issue having the most demoralizing effect on the labs and on the quality of our work is the lack of stability in funding.

Rapid and unpredictable oscillations in funding of the national laboratories are debilitating to research programs. Unlike other institutions, the national laboratories have no "fly wheel" for most of their programs, which can smooth out the changes in Federal support. Aside from the extreme waste of rescources, these rapid changes (including changes in program direction) can result in poor quality work and the corresponding loss of reputation for competence. The institutional planning process, conducted by the Office of Energy Research of the Department of Energy, has helped in addressing this issue. Further strengthening of the process is needed, however, to develop new funding strategies to avoid these fluctuations.

Again, I appreciate the opportunity to address this Subcommittee and thank you for holding these hearings at Argonne National Laboratory.

Senator PERCY. Dr. Lederman, I'm very pleased to welcome you here. And, again, I deeply appreciate the hospitality that's been extended to me, and to learn more, firsthand, of your own programs at Fermi National Accelerator Laboratory in Batavia. You've been director of Fermi Labs for 3 years, and before that, consultant to the Defense Department. For 30 years, you taught and did research in high-energy particle physics. We're very honored and pleased to have you here. We welcome you to Argonne, and, we're happy to hear your testimony.

TESTIMONY OF LEON M. LEDERMAN, DIRECTOR, FERMI NATIONAL ACCELERATOR LABORATORY, BATAVIA, ILL.

Mr. LEDERMAN. Thank you, Senator Percy. It took the Lord 6 days to create the universe—I'd have a problem explaining it in 6 minutes or less—it's rather difficult. Fermi Lab is a single-purpose lab, devoted to providing facilities for research into the basic structure of matter and energy. Our users are physicists from some 80 U.S. universities. But we also are host to visitors from about 25 foreign countries—it's probably the most international laboratory in the world.

Basic research, such as is carried on at Fermi Lab, is usually defined as: "That activity which is supposed to add scientific knowledge, without any predictable connection with utility or application." History and current experience, however, indicate that there is no barrier between knowledge and use, and that basic research is sort of an eminent blend or an alloy of the profound and the practical.

In my prepared statement, I go into a few more details, but, in the interest of time, I'd like to skip over that. A lot of this has been said. There are many paybacks of basic research—and I list both the very important cultural paybacks and the economic paybacks. And, the importance of training of Ph. D.'s in this very trying kind of frontier research. We're an exporter of valued, highly trained Ph. D.'s, which go out into the applied sciences, into industry, and service the science and technology of the Nation.

One of the points that was not made very clearly about the needs of basic research for the country has to do with the crises in the 21st century. If you look ahead and you see what kind of crises are created in technological society, I think you can anticipate some that might make energy sufficiency a crisis in a teacup. And, some of these are perceived—like the acid rain or possible ozone-layer disturbances, or climatic changes due to carbon dioxide in the greenhouse effect. And, the realization that a 1° change in the average temperature of the Earth can have an enormous effect on agriculture and ocean levels.

There are shortages of minerals, surely in the United States, and possibly, worldwide, that fuel our technological society—things like vanadium and chromium and cobalt and tin, and even high-grade iron ore. There is, facing us, surely a population of something like 8 billion people in the early 21st century—and all with rising expectations, because they can watch what goes on in the world in living color. There's computerization, and threats to privacy. And there are—most terrifying—the hazards that we cannot anticipate. And then, there's the ultimate hazard—nuclear war.

My point is that these are larger consequences of technology, and that the solutions require much more technology, but the necessary basic research for which may not yet exist. If you say it, the very survival of technological society and our industrial society may depend on the basic research base. Then, it would seem just as important to defend the Nation against these impending threats as it is to attempt to guarantee security in the military sphere.

Much has been said about R&D in Illinois, and these things I don't have to say. I'd rather take advantage of Senator Percy's relaxation of Washington style and, really, ask Senator Percy a question, if I may. And that is: You may know that we have enormously distinguished representation in Congress from Illinois and from the midwestern area. But we do suffer from the fact that we have no membership and hence no direct inputs to the relevant science and technology committees. And, I would like to ask Senator Percy whether he thinks some mechanism could be set up whereby the Illinois Caucus, or perhaps the Midwest Caucus would establish a dedicated staff of a few people who would concern themselves, 100 percent of their time, on this R&D question—be available for input to the laboratories and universities, so that we can get this kind of early-warning feedback as the budget wings its way through the early stages, the midstages, and the late stages. This is the end of my testimony. Thank you. [Applause.]

Senator **Percy**. The short answer to your question is "Yes." [Laughter.] The long answer is that, the procedure would be that I will present the idea to the Illinois delegation at our regular monthly meeting. I would suggest, because we have no staff for that coalition, that we all contribute to the Midwest-Northwest Coalition of Senators, and contribute funds from our own accounts—they do have a staff. We will, as a delegation, present it to the coalition for the Midwest, particularly, and see whether staff assistance can be provided. Now, if there's any staff assistance that can be loaned to us for this purpose, we would officially swear them in as members of that coalition. I'm not quite sure where we'd find enough funds for that; we're all very tight in budget, and we've all been slashed ourselves. But the answer is: "Yes, we'll go to work on that." Now, may I ask you a question? [Laughter.] Could you, with your vast knowledge, and coming from a laboratory that has been actually increased and has a fairly firm budget—we all rejoice in that—could you give us some suggestions and ideas that I could take back, and certainly, that Dr. Massey could take back, to our congressional delegation, as to what projects you see might be transferable back to Argonne from other places. Places where, logically, there may be an overload—where there's a personal shortage. Some place—something that we can do to get our hands on programs that—just to get more money is one thing. But, if I can find programs that logically can be transferred, it's the same thing—the money comes with the program then. Could you give us that kind of technical assistance?

Mr. **Lederman**. I certainly will try to think about that, and come up with some good suggestions.

Senator **Percy**. Thank you, Doctor.

A final question: I know that you keep up on all the world scientific developments. There's another accelerator, much like yours, located in Switzerland. In your travels, as in mine, you've probably noticed the increasing number of American scientists working actually in Europe and around the world. What attracts them there? And, what are the long-term implications of this if more and more of our scientists, educated and trained here, instead of working and developing technology and scientific development—product development for the United States, actually take their education and skills abroad and develop it abroad?

Mr. LEDERMAN. What attracts them is, simply, the facilities that the Europeans have assembled in that laboratory in Geneva. It is a problem. They outspend us in that particular by at least a factor of two, and their growth rate is also impressive. I think that what attracts them is facilities. And, the net effect of it is, in one word, I think, a disaster. I think it's been stressed over and over again, especially in your opening remarks. To be second in science very quickly becomes second rate and unworthy of doing. You can't ask a scientist to spend 5 years of his life doing research, and then finding out that someone else did it somewhere else, better and sooner—so he leaves. We have to have first-rate facilities.

Senator PERCY. Thank you very much indeed. [Applause.]

[Dr. Lederman's prepared statement follows:]

For: Field Hearings
Energy, Nuclear Proliferation
and Government Processes Subcommittee
March 22, 1982 - Argonne National Laboratory

STATEMENT OF LEON M. LEDERMAN
DIRECTOR
FERMI NATIONAL ACCELERATOR LABORATORY

THE SPEAKER

My comments on the importance of science to the future survival of our society is based upon a career experience in science, beginning with my Bachelors Degree in Physics in New York, my experience in Radar Research and Deployment as a Lieutenant in the U.S. Army during WWII, my Ph.D. at Columbia University 1946-1951, about thirty years of teaching and research in High Energy Particle Physics including ten years of consulting with the Department of Defense (1959-1970) and almost three years as an administrator of a large laboratory - devoted to providing U.S. universities a major facility for research into the properties of matter.

BASIC RESEARCH

Scientific research spans a very wide spectrum of activities and motivations. The importance of R&D is measured by its scope - about $80 billion will be spent by the U.S. Government and by industry in 1983.

Basic research is usually defined as that activity which is supposed to add to scientific knowledge without any predictable connection with utility or application. History and current experience, however, indicate that there is no barrier between knowledge and use - that basic research is an intimate blend of the profound and the practical. Fermilab is a single purpose laboratory, devoted to providing facilities for research into the basic structure of matter and energy. Our users are physicists from some 80 U.S. universities but we are also hosts to visitors from about 25 foreign countries.

Our research deals with the identification and the properties of the basic constituents, out of which all matter is composed. These can only be studied by means of bombardments with particles of extremely high energy such as are provided by our 400 billion volt accelerator. In very recent times, the results out of the accelerator labs, when combined with astronomical data, have been synthesized into a rapidly developing theory which promises to provide a complete picture of the functioning of the physical universe, from the earliest fractions of a second after creation to confident predictions as to how the universe will evolve in the future.

Fermilab, its university users and sister laboratories (and including a crude count of similar, very basic research in mathematics, biology, other physics disciplines and chemistry) is supported at a level of about $2 billion per year (out of a "basic research" budget of $6 billion a year). There is a very lively debate in the science policy literature on why society should invest in this work. A good fraction of this debate is stimulated by Congressional concern over the level and pace of U.S. support of science.[1] I wish to make three points in this brief presentation.

1. PAYBACK OF BASIC SCIENCE

The basic science* defined above pays back to the society that supports it a benefit which far exceeds the investment. Part of this payback is in concrete economic utility terms i.e. measured goods and services. An important, perhaps the most important payback of basic research is cultural. Cultural influences affect society in profound ways.

---

* I chose not to discuss development, applied science or even basic science in mission oriented research since these activities have their own constituencies. The subjects I discuss are, in every sense, and in the language of the present administration, "long range, high risk and high yield" activities.

They are difficult to quantify (perhaps because economics is still a young science!) since no one knows how to measure the value of the substitution of rational thinking for superstition, or to measure dignity or the aesthetic value of knowledge, or the influence on philosophy and religion of an ever deepening comprehension of the world in which we live.

An intermediate payback time (somewhere around 20-40 years) is the application of the results of fundamental knowledge to societal well-being. Clearly to understand the nature of things is a first step towards manipulation or modification for the benefit of society.

Examples here from the recent past are:

1. The application of the results of pure research on the structure of DNA (1953) to gene splicing (1973) and the subsequent explosion of a new biotechnological era.
2. The application of inventions in particle counting techniques to digital computers and the push on industry by the accelerator laboratories to faster and more powerful central computers - this had a major role in the growth of computer technology in the 1950-1970 period.
3. The massive application at Fermilab in the 1974-79 period of the technique of superconductivity which had a seminal effect on the industry with vast potential applications in power, transportation and a large variety of other industrial processes.

If we try to evaluate the total value of goods and services which followed from a complete listing of such examples, we arrive at a large fraction (perhaps as much as

50%) of the GNP, that fraction which is based upon technology created since ~ 1920's. The shortest payback time is in technological goods spun-off from the inventions devised in order to carry out basic research. Here, going back about ten years we have compiled examples which yield tens of billions of dollars of goods and services and I list these, not all as yet quantified, in a detailed paper accompanying this presentation. Perhaps the most valuable product of the kind of basic research we do at Fermilab is the production and "export" to all areas of applied science, of highly trained and motivated Ph.D.'s. Time just does not permit me to go into details even as dramatic as Fermilab's Neutron Cancer Therapy Facility, the most extensive of its kind in the U.S.

2. TECHNOLOGICAL RISKS AND NATIONAL NEED FOR BASIC RESEARCH

The second point I wish to make has to do with projections into the future and the risks which industrial society runs as we enter the 21st century. Some of these dangers are very controversial e.g. is there enough nickel recoverable from the earth's crust to satisfy the needs of industrial society in the year 2000? For nickel you can read cobalt, vanadium or any number of exotic metals which have become necessities if you want to continue to reap the benefits of the computer age, energy sufficiency or biotechnology.[3] And so, I give what is surely an incomplete list of hazards:

1. Environmental disasters: acid rain, ozone layer disturbances, ocean pollution, large scale industrial or auto pollution including chemical and radiation hazards, etc.
2. Climatic changes - CO_2 and the greenhouse effect, natural cycles of cooling. A one degree change in the average temperature of the earth can have enormous impact on agriculture, ocean levels, etc.
3. Vast expansion of terrorism e.g. a coordinated attack on industrial society by third world terrorists.
4. Shortages of minerals and other natural resources, e.g. nickel, vanadium, chromium, cobalt, tin, helium, even high grade iron ore.
5. Natural disasters - major eruptions of volcanos, earthquakes, impact of meteors, etc.
6. Overpopulation and world wide food and/or water shortages. (Prediction of 8.5 billion people by 2020!). Here one must add rising expectations which follow from improved communications and which put additional stresses on resources.
7. Computerization and the threat to privacy.
8. The ultimate hazard of nuclear war.

My point here is that these are largely consequences of technology but that the solutions require much more technology, the necessary basic research for which may not yet exist. For example, if minerals are in short supply, can we design around their needs?

As the population of the world continues to grow and the pressures on energy and other resources and their environmental effects increases, the very survival of technological society may depend on the basic research base. Here we assume the existence of requisite political wisdom. It would seem just as important to defend the nation against these impending threats as it is to attempt to guarantee security in the military sphere.

It is interesting to note that Western Europe, with a population and GNP about equal to the U.S. spends twice as much on its High Energy research as we do.

3. R&D IN ILLINOIS

My third and final point brings us down to local concerns and local problems. I happen to believe that Fermilab is the best laboratory devoted to basic research in high energy particle physics in the world. We are deeply concerned about our support, about our ability to attract competent staff and about the plight of young investigators, those who must wait extra years to get on our schedule of only 23 or so operating weeks per year.

We believe that the Chicago area has the possibilities of developing a Route 128 or Silicon Valley industrial complex, given some real commitment on the part of the State Government and on the part of the Congressional delegation. What are these requisites? The area must compete with the Northeast, California and the Sun Belt for that rare commodity, the gifted scientist and engineer. A careful case study[4] lists, as primary, the need for first rate universities and a kernel of research laboratories. The study cites other requisites, i.e. excellent public schools, libraries, theatre, museums, art galleries, decent housing, access to a symphony orchestra, chamber music, decent restaurants and the like. These can help enormously to attract the necessary people. We need to reexamine these factors in a partnership with the City of Chicago and the suburbs where Fermilab, Argonne, Bell Laboratories, Amoco and Nalco form a core around which a vast expansion could indeed take place.

What has in fact been happening is that Illinois is near the bottom of the list of States receiving Federal return on taxes contributed. A few newspaper articles illustrate this. This is close to a real economic disaster for the region.

Now Illinois has a distinguished and very influential Congressional delegation. However, from the point of view of R&D in the area, we must be frank and say that until now they have not helped. There is not one congressman or Senator on a relevant science committee and in a position to protect the science and related education budgets for this area. Incidently, much as I favor increases in the Fermilab budget, if the present trends in support of graduate education continue, the potential long range penalties will be far worse for the country. I am very greatly encouraged by this hearing as a sign that perhaps, things may change.

Fermilab does have sound scientific ambitions for a large expansion - a one or two billion dollar project that would double our annual budget and staff. We are fairly confident that we can eventually sell this to the scientific community. However, there are serious problems in our Congressional support structure. We do need the sensitive attention of our delegation and in my final remark, I'd like to make a suggestion.

The suggestion is this: that the entire Illinois delegation acting together, establish a small staff - perhaps two or three people, based in Washington and 100% dedicated to supporting the R&D and graduate education efforts in the region. This staff should be in good communication with the universities and research labs in the area - and should be able to call on those congressional delegates closest to whatever the relevant action is. The Illinois delegation must make ties with important science and education committees so that their considerable influence can be exerted. We need continuous attention. It is better to be ignored than to be supported for a time but then, at some critical juncture, to find that we have lost your attention.

SUMMARY

Basic Research pays for itself because of its historic contribution to culture, because of the technologies (almost all we have) which rest on the scientific discoveries and because of technological spinoffs of incidental inventions.

The continued health of basic research is not only mandated by the above but must also be protected in order to buy insurance against a vast array of poential disasters that face industrial societies in the next fifty or so years. These threats are at least comparable to the perceived threat to our military security. They should receive comparable attention.

The vigor and prosperity of the Chicago area and the Midwest in general face dim prospects unless there is a very large improvement in the attention given to the in-place institutions and the social and intellectual environment by the State and its Congressional Delegation.

Footnotes

1. See for example A Report to the Committee on Science and Astronautics by the National Academy of Sciences: Basic Research and National Goals, March, 1965.

2. Cultural Influences of Science, a partial listing:

   a) Replacement of dogma, superstition, divine right of kings, witchcraft etc. by modes of rational thought and planning.

   b) Scientific world view influences philosophy, mans place in the cosmos and his concern about environment - "spaceship earth" (NASA pictures) teaches us a new humility and awareness of the uniqueness of our planet but also its fragile loneliness in space.

   c) Methodology has permeated softer disciplines e.g. economics, political and social "science," anthropology, etc.

   d) Offers satisfaction, pride, dignity aesthetic pleasure and inspiration to millions who made Einstein a folk hero and who tune in on SAGAN and buy OMNI, QUEST, SCIENCE 82, DISCOVER, etc.

   e) Acts as a lure to the young and curious - a major factor in recruiting capable people into science - many end up doing more useful things.

   f) Its fundamentally international character forges bonds and understanding between important components of societies with diverse political and cultural heritage.

3. I can refer the interested reader to extremes of pessimism: Limits to Growth, D.H. Meadows, D.L. Meadows et al, New York, Universe Books, 1972 or extremes of optimism: The Next 200 Years, H. Kahn et al, William Morrow, N.Y., 1976. A middle ground is struck by: Models of Doom: A Critique of the Limits to Growth, New York, Macmillian 1975.

4. The University and Regional Prosperity, David Allison, Internation Science and Technology, April 1965.

Senator PERCY. Our next guest, Dr. Robert Hansen, director of Ames Laboratory, and director of the Energy and Mineral Resources Research Institute at Iowa State University. We're happy to welcome a neighbor.

You have a very distinguished scientific career as a world-renowned expert on surface chemistry. We're happy to hear your testimony.

TESTIMONY OF ROBERT S. HANSEN, DIRECTOR, AMES LABORATORY, AMES, IOWA

Mr. HANSEN. My testimony, of course, as presented here, will be very much abbreviated, but I've given a statement separately to your staff. I actually had some slides—I will defer those as well.

Many of our problems, in miniature, are problems that Argonne has talked about. We are more heavily involved in basic science, basic energy sciences, which have been supported more stably than the applied sciences. We took our shellacking on the fossil and solar programs this fiscal year. They, very largely, evaporated, so we had to reduce our staff by about 15 percent. The total applied program was so extensively and suddenly revised, there was, apparently, no internal mechanism for them to handle the disparate effects on the laboratories—none really exists.

From the long-range point of view, I think I'm rather in favor of some of the policies of the present administration in the direction of focusing the national laboratory effort on high-risk, highly interdisciplinary and longer range research efforts, less on very short-range projects, and less on large, demonstration projects. All of which, I think, in the case of the very short-range projects, probably could be done better by private industry and should be. And, the very large demonstration projects, in my view, have often gone off with insufficient research support before they started.

The problem, though, in the implementation of that is exactly the reason that you mentioned initially. If one is going to move into the high-risk, longer range research, one in no way can do that if one is going to have gyrations in the support of it by a factor of 3 in staffing every year. There's no way a laboratory can manage a program like that—there's no way it can staff it in a stable way. So in the long run, there's no way that work will get done with that kind of a model. And, I trust that can be rearranged. I think all of the laboratory directors are used to adjusting programs to reflect changing national priorities if only they can be leveled with as to what those priorities are going to be and if the Nation is going to stick to them for a little while. [Applause.]

Senator PERCY. Thank you very much. I think that's laying it right on the line, and I'm going to ask you to do so on this question:

When the Department of Energy was created, the Atomic Energy Commission was abolished. How much coordination and consultation was there, between officials of the Atomic Energy Commission and the lab directors? And, how do you compare that to the amount of consultation that there is now, between the Department of Energy and the lab directors? And, is there room for improvement?

Mr. HANSEN. Yes. [Laughter.]

Senator **Percy.** Do you want to expand that?

Mr. **Hansen.** I find, from my own point of view, our interaction with Dr. Trivelpiece and his staff to be very satisfactory. The broader interaction, with the whole Assistant Secretariat arrangements within DOE has been nowhere near so satisfactory. And, in fact, I would say it's been remote. And, I would even go so far as to say that it is not plain that they care what the laboratory directors think.

Senator **Percy.** Thank you very much.

[Dr. Hansen's prepared statement follows:]

Statement
by

Dr. Robert S. Hansen, Director
Ames Laboratory-USDOE

AMES LABORATORY-USDOE
Iowa State University

The Role of the Ames Laboratory

The Ames Laboratory's role is to conduct basic research addressed to correcting deficiencies in our understanding of the physical, chemical and materials sciences which underlie energy generating and other technologies essential to national interests. The Laboratory will execute this work not merely to add to our storehouse of knowledge or as an end in itself, but so that it can contribute (along with the other National Laboratories, Universities and Industry) to the continuing achievement of national goals.

The Laboratory will carry out fundamental work, especially in materials and chemical sciences, to support energy technologies that may reasonably be foreseen in the intermediate to long-range regime (i.e., 15-30 years in the future), will pursue novel, "high risk-high payoff" solutions to problems associated with these technologies, and will conduct energy related, intermediate-range applied research through the proof of technical soundness.

The Laboratory will continue to use its traditional strengths in materials preparation, chemical analysis, chemical sciences and materials sciences as well as its recently established expertise in nondestructive evaluation (NDE) to conduct the long-term basic and intermediate-range applied research needed to solve the complex materials problems encountered in energy production and utilization.

The Laboratory will maintain its internationally recognized capability for preparing ultra high purity and well-characterized metals, alloys, compounds, and single crystals and will continue to make these materials available to other DOE Laboratories, and when appropriate, to universities and the private sector.

The Laboratory will continue to cooperate with Iowa State University in the training of new scientific and engineering professionals (for both academia and industry) by appointing graduate students and postdoctoral associates to positions having direct involvement in its research programs. Thus, the Laboratory will help to regenerate that element of scientific personnel upon which it and similar institutions depend.

The Laboratory's role differs from the general university research role in that the Laboratory will conduct mission-oriented, interdisciplinary and collaborative research whereas universities tend to more effectively pursue projects that are aligned with the academic interests of single investigators. The Laboratory's role differs from that of industrial research entities because the Laboratory conducts open research that is unlikely to support a viable commercial enterprise within 5-10 years, whereas industrial research and development is usually directed toward proprietary projects which have high potentials for commercialization in 5 years or less.

Laboratory Background and Character

The Ames Laboratory is a national, multiprogram, government-owned, contractor-operated Laboratory of the United States Department of Energy. Iowa State University is the operating contractor through its Energy and Mineral Resources Research Institute (EMRRI) and the Laboratory is physically located on the University campus. The contractual relationship and the internal organizational structure are shown in figures appended to this statement. The large majority of the Laboratory's 94 scientific group leaders are members of the University faculty, and a substantial fraction of the basic research is performed by University graduate students holding research assistantships in the Laboratory. Since the Laboratory's inception in 1947, 1050 Ph.D. and 850 M.S. degrees have been awarded to students who based their theses on such research. Laboratory contributions to the scientific and technical literature in calendar year 1980 included 237 refereed journal articles, 46 conference papers, and 35 other technical publications. The total FY 1982 budget is approximately $17.5M and the Laboratory's staff is currently about 410 FTEs.

The Laboratory's basic research program has emphasized the disciplines of chemistry, metallurgy, and solid state physics. Major objectives have been the preparation, characterization, and evaluation of the properties of metals, their alloys and other solid state materials. In striving to achieve these objectives, the Laboratory has historically been involved in thorough studies on the preparation chemistry of these materials and their compositional and structural characterizations. The latter have involved precise measurements and theoretical interpretation of magnetic, electrical, optical, elastic, and mechanical properties of these materials over wide temperature and pressure ranges.

The Laboratory originated in the early days of the atomic energy program because of the expertise available at Iowa State University for the separation and purification of what were then exotic metals. Essentially all of the metallic uranium that has been utilized in the western world has been prepared using processes developed at Ames. In the interim years, efficient purification and reduction processes have also been developed for thorium, zirconium, hafnium, yttrium, all of the rare earths, vanadium, chromium, niobium, calcium, and magnesium; all of the processes have been adopted by industry and most are currently being used for metal production.

With the advent of ERDA and DOE, the activities of the Ames Laboratory shifted strongly to the preparation and characterization of new materials in support of a broad range of energy technologies. Examples of recent significant developments are the following: (a) a new technique for producing high current density superconducting Nb_3Sn-Cu composite wire; (b) development of procedures to control the electronic character of amorphous silicon, with important implications for more efficient photovoltaic conversion; (c) the study of refractory metal systems for the development of alloys with high temperature strength; (d) development of techniques by which the corrosion-resistant but normally brittle material DURIRON can be extruded into useful shapes; and (e) the establishment of an integrated program in quantitative nondestructive evaluation which, when coupled to our other materials sciences, materials characterization, and engineering materials activities, constitutes a significant and unique thrust in materials reliabilty.

A concurrent vigorous research program on advanced analytical and characterization methodologies, along with staff development and equipment procurement, has provided the Laboratory with the capability to properly assess the compositional and structural properties of materials under study. The compositional characterization capabilities resident in the Laboratory have matured to the point that they represent an important national asset. Because these capabilities extend to ultratrace concentration levels, for both inorganic and organic constituents (including biologically active materials), it is not surprising that their utilization has developed far beyond materials characterization. State-of-the-art methodologies for the sampling, detection, measurement and monitoring of potentially toxic pollutants have been increasingly applied to environmental studies supported not only by the DOE but other Federal agencies as well. Many of the instrumental concepts developed at the Laboratory have been commercialized, leading to entirely new technological enterprises.

Laboratory Trends and Long Range Plans

The period 1967-1974 was a time of serious contraction for the Laboratory. During 1969-1971 a Reactor Division program in special metals preparation and properties, accounting for 15% of the Laboratory's budget, was phased out, and during 1971-1973 the Laboratory's medium energy physics program was also phased out. Due to these actions and inflation without compensating funding increases, the Laboratory's 1974 manning level had dropped to 59% of its 1967 level; this reduction caused serious personnel placement and management problems, but in spite of this, output of refereed journal articles in FY 1974 exceeded that in FY 1967.

In FY 1973 Ames Laboratory programs were almost entirely supported by the Division of Physical Research, AEC. Based on experience of the previous five years it appeared extremely unlikely that support from this Division would grow to permit recovery of a reasonable fraction of manning losses. A strong effort was therefore mounted to develop programs in applied areas with particular emphasis on programs that coupled well to the basic Laboratory strengths in materials and chemical analysis previously mentioned. Such programs have developed substantially since 1973 and now account for about 30% of Laboratory funding. Current major sponsors include the following: DOE Offices, CE, DP, ESH, FE and NE; DOE Field Laboratories and Installations LASL, LETC, METC, and; Other Federal Agencies, NRC, AFOSR, DARPA/AFML, Navy, NASA and EPA.

Although our efforts in intermediate-range applied research will be significant, the Laboratory will maintain a strong position in basic materials research, believing that definitive evaluations of well-characterized materials must underlie all of the major energy technologies of the future regardless of type. We foresee a greater emphasis on optical and surface properties of materials, nondestructive evaluation of materials, behavior of materials in hostile environments, superconducting materials, ceramic and composite materials, and the rapidly developing areas of metal-rich compounds.

The Laboratory intends to expand its basic research in chemistry, particularly in those areas related to coal conversion. Work in these areas again will feature thorough characterization of reactants, products, and reaction pathways and their theoretical interpretation. We regard the basic science underlying coal conversion to be unsatisfactory, and believe it will continue to be so until such definitive studies are done. The Laboratory also has significant and exciting programs in nuclear science physics, high energy physics, applied mathematics and engineering sciences that address frontier areas of basic sciences. These long-range research programs are vigorous and dynamic in spite of their relatively small size and provide a stimulating component to the Laboratory structure.

The strengths of the Ames Laboratory, its role as a national multiprogram laboratory, and the nature of certain generic problems which bear upon energy production, permit the description of some of the Laboratory's long-term (20 years or more) future activities. For example, the Laboratory will conduct basic research required to support the development and characterization of materials which are strong and corrosion resistant at high temperatures. Such materials will be needed for any energy technology based on the conversion of heat to electricity; fundamental thermodynamics dictates that the conversion efficiency increases as the conversion temperature increases so the need for high temperature materials for conversion devices will persist well into the future.

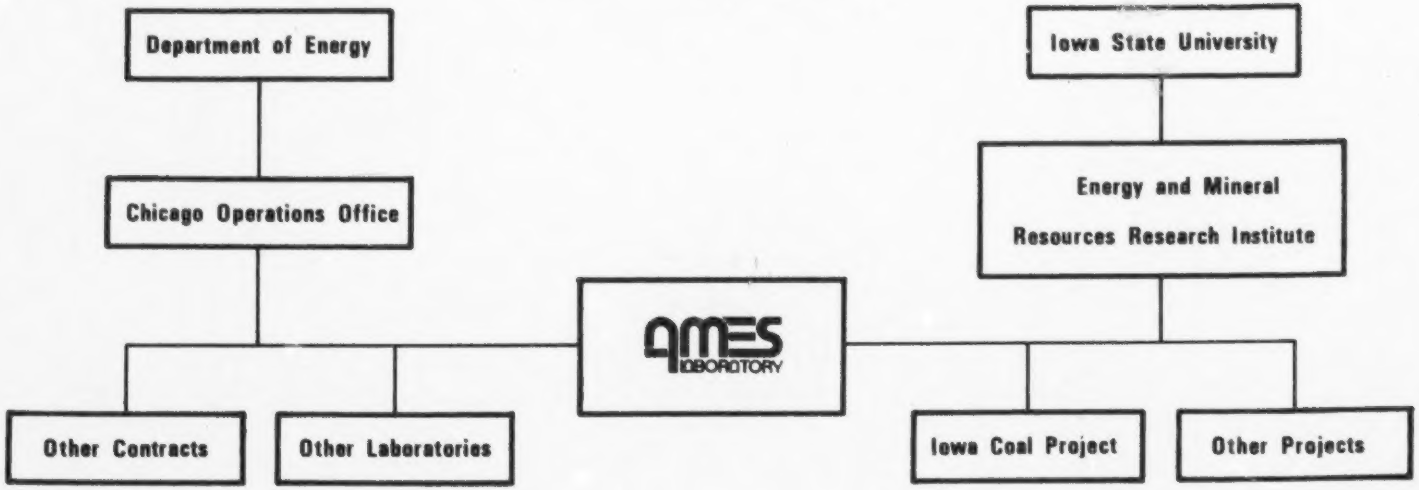
The Laboratory will pursue the materials, analytical, and chemical sciences which will underlie the characterization and development of structural materials suitable for and reliable in hostile environments. This work will also involve development of flaw detection and fracture mechanics science, forecasting lifetimes under varied service conditions, development of in-service testing technologies, translating this information into management strategies (e.g., accept-reject criteria in components manufacture, and retirement for cause criteria for in-service inspections). This work is vitally needed because capital costs of energy conversion technologies have come to be major fractions of the per-unit costs of energy produced. These large capital costs are, to a significant degree, the consequences of overdesign and major redundancies which are incorporated in the energy generating systems because we do not at present have an adequate scientific underpinning to do otherwise. The Laboratory is committed to the development of this underpinning.

These items are illustrative of major thrusts we expect to continue for at least two decades. Others, whose duration may be approximately this long, include fundamental chemistry of coal and coal processing and chemical speciation (identification and quantitation of compounds as contrasted with elements) especially as applied to energy processes including process wastes. Certainly, new visions of national needs will arise in the next two decades, and many of these will require new fundamental information in chemical and materials sciences for their realization. The Ames Laboratory expects to respond vigorously and effectively to these requirements. In so doing, the Laboratory will fulfill its stated role and continue to attain scientific and technological achievements of the outstanding significance possessed by its previous accomplishments, some of which are listed in an attachment to this statement.

Attachment 1

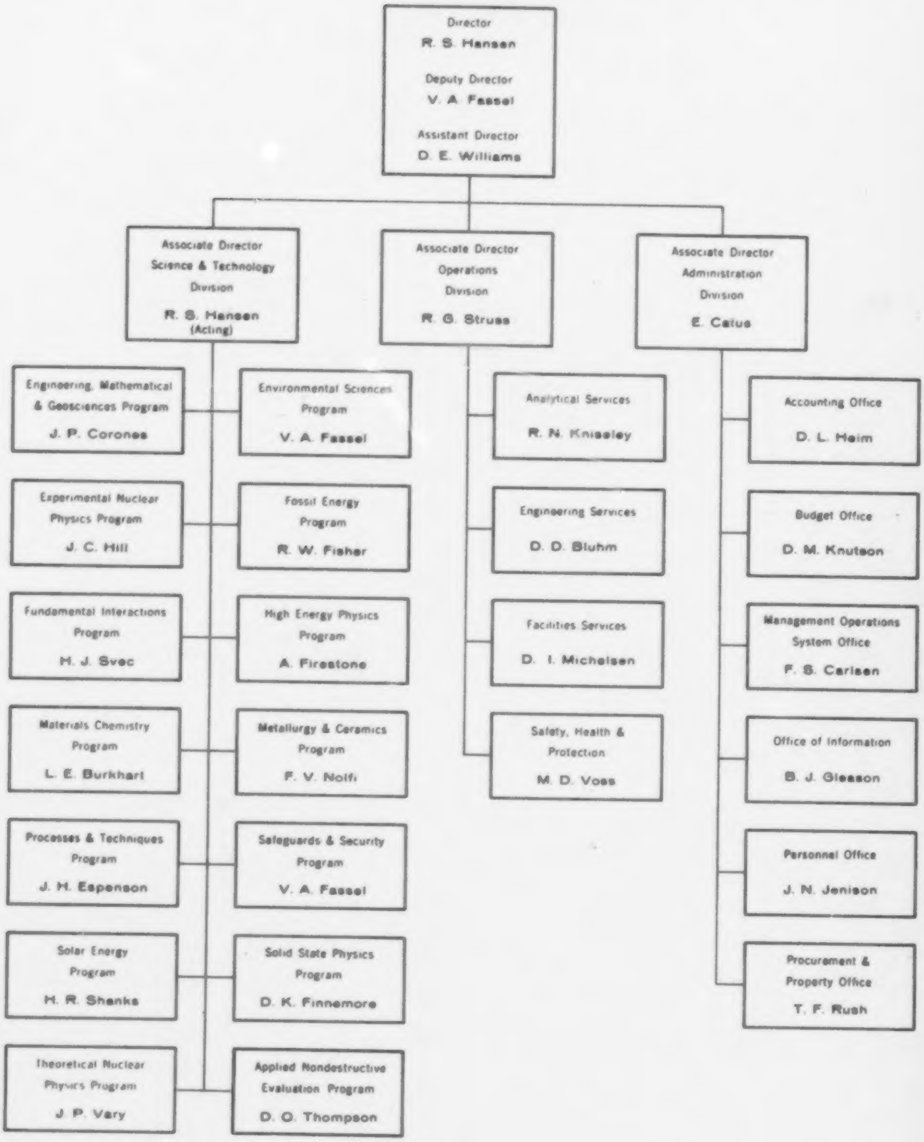
CONTRACTUAL RELATIONSHIP

U.S. Department of Energy
and
Iowa State University



Attachment 2

AMES LABORATORY ORGANIZATION


Director
R. S. Hansen
Deputy Director
V. A. Fassel
Assistant Director
D. E. Williams
Associate Director Science & Technology Division
R. S. Hansen (Acting)
Associate Director Operations Division
R. G. Struss
Associate Director Administration Division
E. Calus
Engineering, Mathematical & Geosciences Program
J. P. Corones
Environmental Sciences Program
V. A. Fassel
Experimental Nuclear Physics Program
J. C. Hill
Fossil Energy Program
R. W. Fisher
Fundamental Interactions Program
H. J. Svec
High Energy Physics Program
A. Firestone
Materials Chemistry Program
L. E. Burkhart
Metallurgy & Ceramics Program
F. V. Nolfi
Processes & Techniques Program
J. H. Espenson
Safeguards & Security Program
V. A. Fassel
Solar Energy Program
H. R. Shanks
Solid State Physics Program
D. K. Finnemore
Theoretical Nuclear Physics Program
J. P. Vary
Applied Nondestructive Evaluation Program
D. O. Thompson
Analytical Services
R. N. Kniseley
Engineering Services
D. D. Bluhm
Facilities Services
D. I. Michelsen
Safety, Health & Protection
M. D. Voss
Accounting Office
D. L. Heim
Budget Office
D. M. Knutson
Management Operations System Office
F. S. Carlsen
Office of Information
B. J. Gleason
Personnel Office
J. N. Jenison
Procurement & Property Office
T. F. Rush

Attachment 3

AMES LABORATORY-USDOE
Iowa State University

SELECTED SIGNIFICANT ACCOMPLISHMENTS

- The Ames Laboratory developed efficient reduction and purification processes for uranium, thorium, the rare earths, zirconium, hafnium, yttrium, and vanadium. These accomplishments span the period from the 1940s to the present. All of the processes have been adopted by industry and all are in use today. Essentially all of the uranium used in the Western world has been prepared by the Ames process and the entire rare-earth industry is largely dependent upon the basic separations, chemical, metallurgical, and materials characterization achievements of this Laboratory.

- The development of the inductively coupled plasma atomic-emission spectroscopy method for multi-element analysis was carried out at the Ames Laboratory during the 1970s. The method is very fast, requires minute amounts of sample, permits simultaneous determination of up to 50 elements, and for most of these elements is more sensitive than any other method. Commercial instruments based on this development have been introduced; six U.S. companies and eleven foreign companies are now marketing such instruments at a sales rate of about $100M/year.

- Development of a ductile, composite superconducting wire suitable for large scale magnets in the 12 to 14 Tesla range was carried out by an interdisciplinary team of metallurgists and solid state physicists at Ames Laboratory. The material is easy to fabricate and has the high strength and strain tolerance needed for toroidal field magnets in Tokamak fusion reactors. The basic work was begun during the late 1970s and some aspects of it are being continued at the present.

- During the middle to late 1970s, the Ames Laboratory developed the basic science for sampling, isolating, and quantitating the trace organic compounds in water. The isolation techniques have increased detection power approximately ten thousand-fold for most compounds of environmental interest. The methodology has been adopted nationally and internationally by government, university and industrial laboratories.

- We have recently developed a reactive radio frequency sputtering method for the preparation of hydrogenated amorphous silicon films for solar cells. The method permits the preparation of large area films needed for solar panels while retaining careful control of the local environment of the hydrogen ions which is needed for high performance.

- Very recently (1978-1980) the Ames Laboratory has developed a method, based on high resolution solid state nuclear magnetic resonance in coal samples, for determining the sizes of the polynuclear aromatic rings in the molecular structure of coal. These results, compared with similar results on liquid fuels produced from coal, are used to study the effects of the chemical processing steps in liquefaction.

- We have recently completed the development of a laser/mass spectrometer probe capable of determining 62 elements at 1 part per billion to higher concentrations in phases of solids whose dimensions are as small as 10-20 micrometers and applicable to metals, semiconductors and insulators. Accurate analyses can be made without the use of standards.

- Chemical engineers and materials chemists at the Ames Laboratory have developed methods for improved control of the complex chemical equilibrium governing the separation of plutonium from uranium in fuel processing. The programs developed in the work are now being used in nuclear safety and nuclear safeguards programs in the United States (1973-1976).

- The development of a liquid junction solar cell using WSe_2 and $MoSe_2$ with efficiencies of 10% and 9.5% and no detectable photocorrosion of the electrodes after extended illumination was recently (1977-1980) carried out by an interdisciplinary group from the Materials Chemistry and Solid State Physics divisions at Ames.

- Ames Laboratory scientists are responsible for the recent development of a provisional international practical temperature scale (IPTS-76) for use by the entire scientific community. A large portion of fundamental research between 0.5 and 35K was done and the scale was adopted by the International Commission on Weights and Measures (CIPM).

Senator PERCY. Our final witness—and, I'd almost feel compelled to be a little personal, it is the smallest laboratory represented—is David Edgington, director of the Center for Great Lakes Studies at the University of Wisconsin, in Milwaukee.

Just having come, a few months ago from the Middle East and when you look at the Dead Sea that cannot sustain life, you'd wonder what that region would be like if they just had the Great Lakes—all that sea of oil. They'd give their right arm and their right leg if they could just have the Great Lakes there. And yet, we've let the Great Lakes deteriorate. I have been swimming in them for almost half a century, about as long as anyone I know, beginning, delicately, sometimes as early as late May and extending it right almost up until Thanksgiving. I love the Great Lakes, and I get a great thrill every time I fly over in thinking what they do for this tremendous area. And, whether we really realize what an asset we've got. So to have the director, who has that responsibility, with a very small operation, to preserve our future and support this national resource, we're very grateful to have you as the final witness.

TESTIMONY OF DAVID N. EDGINGTON, DIRECTOR, CENTER FOR GREAT LAKES STUDIES, MILWAUKEE, WIS.

Mr. EDGINGTON. Well, thank you very much for the opportunity to speak to you today, Senator Percy. My prepared statement, of course, is much longer than we have time for, so I'll get down to the "nitty-gritty."

Fortunately, the University of Wisconsin supports the center, so we are not directly troubled by the ups and downs of Federal funding. But, in relation to talking about federally funded energy research, we have to recognize that we're talking about the utilization of resources. And, no way can you increase energy production without using water. I'd like to remind our listeners, at the moment, that the Great Lakes contain one-fifth of the total freshwater on the surface of the planet. They provide drinking water for 25 million people in the United States and Canada, they provide a major transportation route between large urban centers and the eastern seaboard, they are used as cooling water for powerplants, and other industrial uses, and they provide valuable resources in terms of commercial and recreational fishing. And they also, surprisingly enough, do provide a moderately safe sink for many of our wastes. The health of this resource, then, is critical to the present and future economic well-being of this region, but it has problems which will require surveillance and understanding.

We're really only just starting to tackle the enormous problems of how toxic chemicals may be contained to preserve water quality. The development of coal and oil-shale resources in the Mountain States are going to require large quantities of water: diversion of lake water has been suggested. This, of course, would, perhaps, give us problems in relation to actual diversion of water and what that does to other resources. But also, it is going to increase the regional air pollution and fallout over the whole country. Which, of course, could affect the water quality of the lakes.

These issues raise questions regarding the control of refuse, as well as point sources, persistence of toxic chemicals in the water column, and the associate ecological and human health risks, as well as the control of eutrophication and extending the winter navigation season. The northern shore of Lake Erie has already assimilated a myriad of gas wells—should we be exploring for gas and oil in other parts of the Great Lakes?

In the last two decades, the Federal Government has established a wide variety of Great Lakes programs, including a very successful one at Argonne—reflecting national commitments to a 1909 treaty, and the 1978 Water-Quality Agreement with Canada. Also, the Clean Water and Clean Air Acts, the National Environmental Protection Act, and the National Ocean Pollution Cleaning Act.

As results of these programs, a number of strong Government and university research laboratories have contributed, through in-house, as well as extramural activities, to a better understanding of Great Lakes ecosystems. The very characteristics that make the Great Lakes a national resource—their large size and water volume—requires the maintenance of a carefully nourished, long-term research and assessment program. The lakes undergo a slow response to insult because of their size, and deleterious effects will tend to creep up on us. Or, as happened with PCB's, be suddenly thrust upon us when our threshhold in analytical capability is exceeded.

These programs must be based on the best technology available, and the universities should play a major role in these programs. But a strong Government presence must be maintained. Therefore, I view the elimination of the Great Lakes Basin Commission in Ann Arbor, the work at Argonne National Lab—which I, of course, for many years was associated with—the severe reductions in EPA programs in Duluth, the Lodge Lakes Laboratory in Grosse Ile, Mich., and the proposed closing of the Great Lakes Environmental Lab of NOAA in Ann Arbor, with considerable concern. Furthermore, reductions in Federal support for grant programs in the EPA's Office of Research and Development and NOAA's Office of Marine Pollution Assessment and sea-grant programs, very importantly, will severely limit our ability to train new environmental specialists in the universities. The closing of Argonne, the Lodge Lakes Lab, and the NOAA GLO programs have and will disperse teams of excellence that have been carefully built up and nurtured over a decade or more, and will severely limit the Nation's capabilities to study the "fate and fix" of energy-related pollutants and to synthesize physical, chemical, and biological data by sound hydrogenamic and biological modeling.

The Great Lakes are of sufficient importance to the well-being of this Nation to recognize that any further erosion of our abiilty to gain a better understanding of the complex processes controlling this ecosystem can only result in a further deterioration of water quality. Research on the Great Lakes has been too fragmented, and now is the time to consider how great a cooperation and coordination may be attained. This cooperation must include all Government laboratories and universities involved in Great Lakes research, so that wasteful duplication is avoided.

The problems of the Great Lakes are real, complex and long term—continued strong Federal support is critical.

Senator PERCY. I thank you, Dr. Edgington, very much, indeed. And, I find it very disquieting when we consider the treasure we have here, which we take so for granted, that virtually the entire Federal research effort for the Great Lakes is being zeroed out in the 1983 budget. And, I would say that's exactly comparable to the situation I described to Secretary Baldrige of a new CEO in a company coming in to make a fast buck, get a stock option up and then getting out and leaving the future unattended. And, those are shortsighted decisions that we simply cannot allow.

[Dr. Edgington's prepared statement follows:]

STATEMENT OF DAVID N. EDGINGTON
REGARDING THE FUTURE OF FEDERALLY-FUNDED
NATIONAL ENERGY LABORATORIES
BEFORE THE U.S. SENATE SUBCOMMITTEE ON ENERGY,
NUCLEAR PROLIFERATION AND GOVERNMENT PROCESSES

March 22, 1982

I appreciate the opportunity to appear before you in connection with the question of the the future of federally-funded energy research. By being associated in this panel with the other laboratory directors I can understand how another David felt when confronted by Goliath. However, today we are here to discuss a common cause and common problems—though their relative severity to each of us is a matter of scale.

The Center for Great Lakes Studies at the University of Wisconsin-Milwaukee is a multidisciplinary organization reporting to the Dean of the Graduate School that was created almost twenty years ago to promote excellence in Great Lakes research. Unlike almost all of the other research and development laboratories with research activities focused on Great Lakes problems, this Center has received, and continues to receive, strong direct funding support from the State of Wisconsin and therefore is somewhat better able to surmount the vicissitudes of the ups and downs of federal research funding. Since many of the problems associated with the Great Lakes can be attributed to the use, misuse, and development of energy sources, it is perhaps appropriate that, although the primary emphasis of the Center is not related to energy, a large number of the research programs have provided the essential, more basic information that has permitted other organizations to assess the effects of energy-related activities on the Great Lakes.

The achievements of the Center cannot be assessed in terms of new hardware development but rather in relation to providing a generic scientific understanding of the physical, chemical, and biological processes controlling the behavior of contaminants of all sorts in the lakes—from excess heat to microcontaminants such as trace elements, polyaromatic hydrocarbons, polychlorinated biphenyls, etc. from a variety of sources both local and regional including power plants—in terms of their transport, fate and biological effects. The impacts of energy production on the lakes are diverse and potentially serious. Thus, a strong basic research program to understand these processes is essential and must proceed in conjunction with monitoring and other assessment programs.

In the past the Center, in terms of individual scientists has provided guidance to the International Joint Commission and regulatory agencies as a result of studies delineating the role of lakewide physical processes on the dispersion of pollutants, particularly heated cooling water from power plants—in the nearshore zone and the possible resultant ecological effects; the effects of the chlorination of power plant cooling water on aquatic biota; and the effects of the dispersion of sewage plant effluents into Milwaukee Harbor, on the nearshore zone of Lake Michigan.

Present programs supported by funds from the state, federal—mainly U.S. EPA and NOAA (Sea Grant and Office of Marine Pollution Assessment), and the private sector involve the assessment of the effects of physical and biological processes on the persistence of energy-related pollutants in the Great Lakes and coastal zones and the effects of energy-related pollutants on fisheries and fish reproduction.

The Great Lakes contain one-fifth of the total freshwater on the surface of the planet. This water is heavily relied upon for a variety of activities. The lakes provide drinking water for 25,000,000 persons in the U.S. and Canada. They are used as a major transportation route between large centers in the Midwest and the Atlantic seaboard, as well as for a variety of industrial uses including hydropower and cooling for other energy sources. They also contain valuable fisheries that—while presently in a state of flux—with proper understanding and management provide recreational opportunities for millions around the shores and other waters and could be a valuable source of high quality protein. They also have assimilated many of our wastes.

As a result, the health of this resource is critical to the present and future economic well-being of this region, but they have problems which require surveillance and understanding. To fully utilize this priceless resource we must understand the basic processes controlling their behavior os that the correct management strategies can be applied. Such strategies must take account of the long-term chemical behavior of pollutants and their biological effects so that environmental impact and unnecessarily strict regulations are minimized.

The cut-backs in federal support for Great Lakes activities and proposed changes in the Clean Air and Water Acts comes at a time when we are attempting to deal with several critical issues related to water quality and use. We are only just starting to tackle the enormous problems to decide how effectively toxic chemicals must be contained to preserve water quality. The development of coal and oil-shale resources in the mountain states will require large quantities of water, and the Great Lakes have been recognized as a possible source. This diversion of water for energy production as well as the long-range air pollution and fallout associated with these processes could impact water quality and resources of the Great Lakes.

Such issues raise questions regarding the control of diffuse as well as point sources, persistence of toxic chemicals in the water column, and the associated ecological or human health risks. What are the effects of non-point source pollution—from the land and air? Are the billions of dollars being, or planned to be spent to control eutrophication, being spent wisely? What would be the effects of the consumptive or non-consumptive export of water from the Great Lakes to water-deficient regions? This involves not only questions regarding the impacts of this inherently fragile ecosystem but also the inter-state and international questions of water diversion. What are the constraints to extending the winter navigation system? How can we further develop, utilize, and protect this resource? The northern shore of Lake Erie has assimilated a myriad of gas wells for many years: should exploration for gas or oil take place as well in the other lakes?

Research designed to provide more precise answers regarding environmental impact is required to resolve these and other issues and to support decisions involving the health, safety, and economics of such operations in the region.

In the last two decades the federal government has established a wide variety of Great Lakes programs reflecting national commitments, among others, to the 1909 Treaty and the 1978 Water Quality Agreement with Canada, the Clean Water and Clean Air Acts, the National Environmental Protection Acta (NEPA), and the National Ocean Pollution Planning Act. As a result of these programs a number of strong government and university research as well as surveillance laboratories have contributed through in-house as well as extramural activities to a better understanding of the Great Lakes ecosystem. The continued support of these activities is essential. The very characteristics that make the lakes a national resource, their large size and water volume, requires the maintenance of a carefully nourished long-term research and assessment program critical. The lakes undergo a slow response to insult because of their sizes and deleterious effects will tend to creep up on us, or, as has happened with PCB's (primarily our energy-related pollutant) be suddenly thrust upon us when a threshold in analytical capability is exceeded. There is a continuing need for surveillance based on the best technology available coupled with a research program that can relate changes in time and space in relation to our best fundamental understanding of the system.

The universities should play a major role in these programs, but a strong government presence must be maintained. Therefore I view the elimination of the Great Lakes Basin Commission in Ann Arbor, energy-related Great Lakes research programs at Argonne National Laboratory, the severe reductions in the U.S. EPA program at Duluth, Minnesota, the Large Lakes Laboratory (LLL) at Grosse Ile Laboratory, Michigan, and the proposed closing of the NOAA Great Lakes Research Laboratory (GLERL) at Ann Arbor with considerable concern. Furthermore, reductions in federal support for grant programs in EPA's Office of Research and Development, and NOAA's Office of Marine Pollution Assessment and Sea Grant Programs will severely limit our ability to train new environmental specialists in the universities.

The closing of the Argonne program last year and the proposed closing of NOAA-GLERL in the 1981 President's Budget will disperse teams of excellence that have been carefully built up and nurtured over a decade or more. The loss of the Argonne program has severely depleted the talent pool of a team capable of measuring and studying the fate and effects of energy-related pollutants, as well as a unique capability in using radionuclides to study lake-wide processes. The closing or severe reductions in the activities of the LLL and GLERL will severely deplete our capabilities to synthesize physical, chemical, and biological data by sound hydrodynamic/biological modeling.

The Great Lakes are of sufficient importance for the well-being of this nation for us to recognize that any further erosion of our ability to gain a better understanding of the complex processes controlling this ecosystem can only result in a further deterioration in water quality. Research in the Great Lakes has been too fragmented and now is the time to consider how greater cooperation and coordination may be attained. This cooperation must include all government laboratories and universities involved in Great Lakes research, so that wasteful duplication of effort is avoided. There must be agreement on the issues and problems to be addressed. Perhaps we need a national Great Lakes laboratory, obviously situated on Lake Michigan, the only lake whose boundaries are totally within the United States. The problems of the Great Lakes are real, complex, and long-term. A continued strong federal support is critical.

Senator PERCY. In concluding this hearing, I want to thank all of you very much indeed for your patient attendance. We have answered the question: What Nation will lead the world into the future? And we've answered the question as to what we need to do to make absolutely certain that we do. Our job is to see that everything given to us is passed on to our children and grandchildren. And the world is looking to us for leadership, for the kind of security and for the kind of growth and progress that the United States of America is so uniquely able to provide.

Now I'm going to ask Richard Graczyk to do something: bang the gavel to close this meeting. [Gavel sounds.]

Senator PERCY. The meeting is adjourned. [Applause.]

[Whereupon the subcommittee recessed, to reconvene at the call of the Chair.]

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

STATEMENT OF JANE M. BYRNE, MAYOR, CHICAGO, ILL.

I am pleased to testify today about the Federal Lab system's importance to the city of Chicago.

On August 4, 1981, I addressed a distinguished group of legislators, civic leaders and businessmen and women who gathered to explore the question of why Illinois, and Chicago, was coming up short in the competition for defense dollars.

In preparing my remarks, I did a bit of research and noted a recurring theme playing through newspaper articles, conferences and meetings on the subject of defense procurement.

The theme was that our low ranking was sort of a mystery according to traditional wisdom, Chicago and Illinois were perfect spots to nurture high technology companies and other operations that could be vendors for government business.

We already had everything needed to be a high tech territory, the experts claimed. Superior Federal laboratories, outstanding universities, industries, businesses, and an amenable city administration. All features in place to woo the computer crowd.

The missing key, though, was a mechanism to link all of these features together and produce a magnet that could lure high tech industries and defense dollars away from the Sunbelt and other high tech corridors to our door.

At the August 4 conference, I announced one solution—the formation of a task force whose goal was to forge that link and boost Chicago to the top of the list for high tech and growth industries

Identifying a leader for my task force was not difficult. Dr. Walter E. Massey, director of Argonne National Laboratory, was the perfect choice to merge research and development, acadamia, and business.

At this point, it appears both my task force and its chairman, Dr. Massey, were smart moves. The 24 members of the task force are recognized leaders in their professions and in civic and corporate communities in the Chicago Metropolitan Area.

Dr. Massey and the task force has been meeting since August of last year and will soon publish an interim report on their activities. The report includes some specific recommendations, and we are confident that the group's findings will indeed lead to the Chicago area assuming its rightful role in high technology development.

At least a part of my confidence is based on the fact that Dr. Massey has agreed to continue serving this city on a long-term basis. As my newest appointee to the Chicago Economic Development Commission.

All of this information should give you a clue that I am hardly a disinterested party in these proceedings.

The survival of Argonne and Fermi Labs, and the continued growth of these centers, is crucial to the city of Chicago's plans for economic development.

Along with being partners in our quest for high tech companies, Argonne and Fermi are an important feature in the intellectual climate of Chicago. This climate is essential if we are to attract and hold scientific personnel needed to organize and staff high technology industries.

Another bonus that the labs bring is that they are a rich source of new scientific entrepreneurs with ideas that can be commercially developed into high tech products and services.

Scientific ideas, geniuses, and technological climate, are a few of the lab benefits that brought me here today.

Another benefit, equally meaningful, is money.

Both labs directly contribute to Chicago's economy through payrolls, taxes and procurement. Argonne employes 325 Chicagoans on their payroll and Fermi, 36.

The total annual payroll going to Chicago residents from the two labs is $8,220,000.

Many of the lab employees do their purchasing in the city, so the $8 million plus makes a significant sales tax contribution to our treasury.

Argonne and Fermi are big spenders, too. Between the two labs, 1981 business purchases totaled $30.1 million, and these purchases are doubly important because they involve high tech products and services, and support minority and small businesses.

Argonne's solar energy program, energy conservation projects, cancer research and advanced nuclear research, are activities that improve the quality of life for all mankind.

Because Argonne's staff are experts in a variety of applied scientific areas, as well as basic research, they provide direct service to Chicago.

Some examples include:

—Radiological assistance teams staffed by Argonne specialists are called in whenever there is a question of radioactive spill from material being transported at O'Hare Field, on the highways or railroads.

—Argonne advises the city on air quality analysis and control strategies for long and short term problems.

—For the Metropolitan Sanitary District of Greater Chicago, Argonne monitors well water for concentrations of radium.

As a city more heavily dependent than most on electricity generated from nuclear reactors, Chicago benefits from the pioneering work done by Argonne that has led to most of the commercial nuclear generators in use today.

From the testimony thus far, you can see that the city of Chicago and our national laboratories enjoy a special relationship that has served both sides well for decades.

Since Argonne was founded in 1946 and Fermi in 1967, the scientific centers have been important in the economic and cultural mix of the Chicago Metropolitan Area.

Considering the hostility that exists between some localities and national laboratories, we are proud that there has never been an organized objection of protest from the Chicago-area public about the operation of the labs. This compatability contrasts the experience of some east coast and west coast laboratories and testifies to the mutual respect between our labs and Chicago.

I urge you not to interrupt that relationship by lessening your support of the Federal labs in our area. Among our many distinctions, Chicago has the longest history as a host city to a national lab, and we are the only city which has two major national laboratories in its area.

Please don't tamper with that distinction.

We are distressed that some national laboratories in the South and Southwest have grown while our laboratories are undergoing cuts despite the high quality of scientific research being conducted here.

We believe the Federal spotlight has shown upon the Sunbelt too long, and the time is right for shifting the beam in our direction.

The maintenance of our national labs as healthy ongoing enterprises is vital to Chicago's destiny. We are eager to work with the Illinois congressional delegation in this endeavor, and we are grateful for this opportunity to speak.

STATEMENT OF BARBARA BANNON-HARWOOD, MEMBER, STANDING COMMITTEE ON ENERGY, NATIONAL ASSOCIATION OF HOMEBUILDERS

The following resolution became official policy of the National Association of Homebuilders at their annual meeting in January:

"NAHB Resolution

"Whereas, sharply rising energy costs during the last decade have fueled inflation and driven up interest rates; and

Whereas, high interest rates and inflation have made it less possible for Americans to buy homes; and

"Whereas, America's lack of control over her own energy destiny causes unprecedented price increases and threatened oil supply interruptions; and

"Whereas, alternatives to foreign oil must be developed which can be controlled within our own country, and two renewable energy resource alternatives which can provide the nearest term benefit at the least cost are solar energy and energy conservation; and

"Whereas, the oil and natural gas industries will receive $54 billion in government subsidies over the next six years, plus $12 billion in tax credits for payments of royalties to overseas governments; and

"Whereas, the administration has proposed to terminate solar and energy conservation tax credits immediately, has reduced solar and energy conservation subsidies to less than $1 billion for 1982 and plans to eliminate almost all funding for them in fiscal 1983, now, therefore, be it

"*Resolved* That the National Association of Home Builders supports reapportionment of fund allocation which would reduce subsidies to oil and gas and shift a percentage of those funds to renewable energy resources, solar and energy conservation, which have direct benefits to American homeowners as well as to the ultimate good of our nation."

Long-term research and development for alternative energy sources, particularly solar and energy conservation, should be a very high priority expenditure for this nation. The impact of a major fuel supply interruption from any source woud have as devastating an effect on our economy and our national security as war, which our government is not hesitant to spend billions defending against. In addition, the impact of further oil price increases would exacerbate inflation, drive up interest rates further and cause further devastation of our industry.

We are also very concerned that the primary focus of government efforts in energy seems to be on fossil fuels, particularly increased production of oil, and on nuclear, rather than on renewables which include energy conservation. President Reagan's own advisory board warned that too much of the federal support for research and development is going into attempts to expand supply and not enough into conservation, yet he rejected their recommendation and days later cut the energy conservation budget to almost nothing. The Energy Research Advisory Report stated, "Conservation has contributed much more than supply augmentation in reducing our dependence on insecure oil imports." It added that the oil industry is fully capable of doing its own research and development and federal funding there should be cut; however, in contrast, the fragmented and financially battered construction industry, which is highly concerned with the development of energy conservation and solar, has very iltle ability to develop technology, and here federal support should be increased.

A recently released study by Georgetown University Center for Strategic and International Studies concluded that the world will face another energy crisis within this decade for five reasons:

(1) Oil demand will increase as economies recover from the recession.

(2) Because of the current drop in oil prices, there will be less effort to switch from oil to alternatives.

(3.) Eastern Europe will soon cease to be an oil exporter.

(4) Third World countries and OPEC nations themselves will experience a rapid increase in oil demand.

(5) The current oil price drop, not perceived to be temporary by many people, will slow essential conservation efforts by industry and individuals because they will appear to be financially unfeasible.

It is in the power of Congress, this Administration, and the American people to improve America's position going into the next energy crisis if we act NOW to prevent the slowing of conservation efforts and to encourage development of renewables. We therefore urge greater incentives and tax credits for renewals, particularly energy conservation and solar.

In closing, I wish to express our gratitude to Senator Percy for his continued efforts on behalf of energy conservation and the housing industry. Thank you.

[From Science Magazine, Mar. 26, 1982]

LONG-TERM ECONOMIC RX: RESEARCH

(By Senator John H. Glenn)

Research and development supported by both government and private sources transformed the United States into the dominant technological force in the world. But our commitment to maintain and extend the amount of research and development necessary to stay ahead in the technological race has slipped. Today we are witnessing a wholesale retreat in the federal role in civilian research and development. This is manifest in the shrinking amount of research support for our universities, private nonprofit research laboratories and national multiprogram laboratories.

Over the past 15 years the proportion of the U.S. gross national product invested in research and development has steadily declined—dropping more than 20 percent since 1965. In the same period and by the same measure, the R & D investment in the Soviet Union climbed by 21 percent, in Japan by 27 percent, and in West Germany by 41 percent. In addition to this huge underinvestment in research and development, we are failing to produce the technically trained people that we need to sustain increases in productivity and to make advances in knowledge that will be the basis for our economic prosperity and national security in the coming decades. The intense demand for technically trained people has resulted in high salaries that are luring faculty and graduate students away from even our best universities. To complete this picture there is mounting evidence that the research laboratories and instrumentation in American universities are rapidly becoming obsolete.

Let us examine the response of the Reagan Administration to this crisis in four specific areas: energy, space, science education, and the national laboratories.

Productive R&D efforts in industrial energy conservation energy-efficient buildings, energy storage, and solar energy have been zeroed out in the President's fiscal 1983 budget, thus helping to ensure an unnecessarily prolonged U.S. dependence on oil from the Arabian Gulf. There is no evidence that any of these programs will be picked up by private industry.

Decisions on the space program are equally egregious. The Galileo Program is now the only remaining U.S. planetary program in development, and some of the older space probes may be turned off. Funds have been cut for a satellite to test new advances in communication. Aeronautics research has been cut at a time when the Europeans are challenging us with the development of the airbus and the Japanese are thinking of launching major forays into the international aircraft market.

In science education, the National Science Foundation's (NSF) request for extra funds to upgrade university laboratories has been zeroed out, and a 70 percent reduction has been forced on NSF in the science education budget. As for the national laboratories, Argonne National Laboratory officials say that 25 percent of their work force may be eliminated within the year. Brookhaven National Laboratory, Fermi National Accelerator Laboratory, NASA-Lewis Laboratory, and Jet Propulsion Laboratory have also suffered.

Several steps can be taken to meet the R & D crisis in America. We must provide stable, predictable, funding for scientific and technological research; alleviate shortages of technical personnel; provide incentives for better university-industry collaboration; restore the science education program at NSF and improve science and mathematics education at the precollege level; and develop a coherent national science and technology policy that includes a larger role for the science and technology community in the making of such policy. If the Office of Science and Technology Policy cannot be sufficiently effective in this role, we should think seriously about creating a cabinet-level department of science and technology as a focal point for federal nondefense research activities. I urge the science community to help us get back on the right track.

Village of
DOWNERS
GROVE

Civic Center • Downers Grove, Illinois 60515 • (312) 964-0300

March 22, 1982

United States Senate Subcommittee on Energy,
Nuclear Proliferation, and Government Processes
Public Hearing on Future of Argonne and Fermi Labs

Gentlemen:

The citizens of Downers Grove know how important it is for their government to spend only as much money as they are given by the people--and still deliver necessary services in an efficient manner.

This is nothing new to the people in our community. During the last decade they have insisted their municipal government live within resources allotted and still maintain excellence. The results have been recognized nationally. So we appreciate how difficult it can be to set proper priorities on any governmental level and maintain fiscal discipline. We thank you for your efforts in this regard.

Our national debate on priorities features all kinds of special interest groups pleading their causes. Frequently, they seem very willing to cut spending everywhere except in their own narrow area of interest. Too often our general national interests seem to come in a poor second to loud and highly organized special interests.

Today, it would be easy to argue the cause of Argonne and Fermi Labs from the perspective of a special interest group. Downers Grove has over 400 citizens employed at Argonne. They are good people and are a credit to our community by their many contributions. No one can doubt the severe negative economic impact to our community if Argonne and Fermi are closed.

We submit these arguments are important to our area--but they are also parochial. They are typical "tunnel vision" arguments advanced by special interests. We suggest that questions of national priorities should not be decided on any other than a national criteria.

The basic question is whether we can afford to abandon energy research that is vital to all our nation. We are considering dismantling a research team that is not easy to replace and perhaps denying ourselves the lead time necessary to solve complex energy problems.

In our judgment, these national research labs are valuable and irreplaceable assets to the American people. Their mission is not simply short range in nature, bureaucratic or red tape oriented, as is the case with many governmental programs. They are engaged in work that promises to produce real, substantive future value to our people.

Today we have a momentary oil glut but the energy crunch is not over. Our future energy independence still depends on developing other energy sources. We believe that using any realistic criteria of national interests, the continuation of energy research must rank high.

Cutbacks in any organization are unpleasant. All too often special interests argue they must have everything they want in resources--or you will get nothing at all in return.

We don't believe this. We have seen just the opposite to be true. We believe that frequently all of us would be better off to cut, say, 15% out of most government programs--and still insist that excellence in results be maintained. This can produce a concurrent reduction in layers of administration, paperwork, regulations and meaningless activity. It can provide a focus on needed results. It can cause more efficient delivery of services using less resources. We reject the "either/or else" tactics being used by many special interest groups. We can no longer afford to be a nation of infinite appetites with finite resources. We can't have everything we want--so we must choose what is most important.

In summary, we urge that you look at the question of Argonne and Fermi Labs from the viewpoint of the most special--and largest interest group of all--the American people. We submit that our future vitality as a people may depend in large measure on work accomplished in these national laboratories. Using a national--and not a narrow criteria--we can't think of anything much more important to any one of us.

Sincerely,

Jon D. Council

Jon D. Council
Mayor

VILLAGE OF DOWNERS GROVE

JDC:la

DuPage Board of Realtors

DUPAGE MULTIPLE LISTING SERVICE
DUPAGE SCHOOL OF REAL ESTATE

621 SOUTH CHASE STREET, WHEATON, ILLINOIS 60187 (312) 653-1790

PHILIP H. MADELL, Executive Vice President

Honorable Charles H. Percy, Chairman
United States Senate Subcommittee on Energy,
Nuclear Proliferation, and Government Processes
The Critical Need for Energy Research and Development:
The Role of the Midwest Research Laboratories

Gentlemen:

The DuPage Board of Realtors is the largest local trade association of Realtors in Illinois, and takes an active interest in the welfare of its members as well as in the communities served by its members.

DuPage County is fortunate to have two renowned national laboratories in its midst: Fermi and Argonne. We are pleased to have not only the facilities as neighbors, but the people of the laboratories as our personal neighbors.

We could tell of all their many contributions to DuPage County, and we could dwell on the economic advantages of the proximity of these fine centers to our county, but others have already touched on these factors.

What we want to encourage you to do is to keep these facilities in tact; not to destroy the teamwork required for the high quality results this country needs from the labs; to recognize the symbiontic relationship essential to quality results; and to keep our two facilities in good economic health. Simply, our country needs the basic research carried out at Fermi and Argonne. Shifting projects away from Argonne will destroy some of the magic needed to accomplish our nation's goals.

We want to state the obvious. Basic research is critical to our country. Both Argonne and Fermi have demonstrated their ability to deliver. Priorities may shift regarding long range research, but long term goals remain fairly constant if they are right to begin with. Let us ensure that we do not deviate from long term goals in the name of shortsighted economics. Fermi and Argonne need to be kept whole if we really are serious in our commitment to quality in America's future.

Very truly yours,

Philip H. Madell
Executive Vice President

PHM:esj

President: Dan Easley, GRI, CRB
First Vice President: Paul Jacobson, GRI, CRB
Treasurer: Tom Passaro, GRI
Secretary: Rudy Krueger
Legislative Vice President: Georgeann Wroble

Moraine Valley Community College
10900 South 88th Avenue, Palos Hills, Illinois 60465, (312) 974-4300

Senator Charles H. Percy
Chairman of the Subcommittee on Energy
For The Congressional Hearing On Energy at
Argonne National Laboratories, March 22, 1982

I am Dr. Byron Kee, Vice President for Instruction at Moraine Valley Community College, 10900 South 88th Avenue, Palos Hills, Illinois, 60465, phone (312) 974-4300.

Moraine Valley Community College strongly urges the Federal Government through the Department of Commerce to make provisions in its budget to assist educational institutions to further develop and expand energy awareness and training programs. Moraine Valley Community College is initiating a two year Energy Management program, and is a member of the Chicago Charter Chapter of the Association of Energy Engineers. In addition, the college is listed in the Solar Energy Research Institute directory.

There has been considerable progress made in the past few years in the conservation of energy resources. Part of the progress can be attributed to energy awareness and related energy programs. Without the continued support of these energy programs, the progress which has been made in educating the public relative to methods of conserving energy may come to a standstill. Likewise, the training of personnel such as Energy Auditors and Managers needed to assist the public in implementing conservation technology and methodology could be greatly curtailed.

Through the continued budgetary support by the Federal Government of energy education and training programs, Moraine Valley Community College and other dedicated community colleges across the country will not only be able to continue with their energy curricula, but will be able to enhance such education through acquisition of needed equipment and development of appropriate laboratory facilities.

Naperville

March 18, 1982

The Honorable Charles H. Percy
The United States Senate
Washington, D.C. 20510

Dear Senator Percy:

As both a Mayor and a private citizen, I have been quite concerned with the cutback in funds to both Argonne and Fermi Labs. Private industry would never cut funds in their research and development, as they realize that research and development is what keeps industry competitive and viable.

Rather than cutting funds, I would like to see either an increase or a status quo on funds to both Argonne and Fermi Labs for the following reasons:

1) The above mentioned labs have a large competent staff of scientists, engineers and craftsmen available now to utilize the two research and development facilities that, in my opinion, are a national major resource immediately available to assist very significantly in the event of a crisis or an emergency. Argonne and Fermi must continue important work on national problems --for example, new energy sources, such as coal conversion and safe toxic waste disposal that will assure the nation's security and well-being, to name a few.

2) Because of Argonne's close location to the many colleges and universities supported by and located in Illinois and the neighboring states and because Argonne's work is so broad in scope, the top graduating students will be encouraged to seek employment in an area that will prove most beneficial to the well-being of our country. Argonne and Fermi Labs will also supply jobs to support personnel.

3) Because of the impressive reputation of these two labs that are recognized internationally for their countless successful projects, we, in the United States, have an asset that must be further utilized. Other major countries, such as Japan, and I am sure, the USSR, are

increasing funds for research and development and not cutting back. If Argonne and Fermi Labs are cut back, we will lose many top graduates to industries located in other states, and these potential research and development personnel will not contribute to keeping our country competitive in the world trade markets.

4) Illinois has a tremendous amount of coal within its borders that, unfortunately, has a high sulfur content. I am sure if Argonne was given the green light, they would successfully devise a method to control the pollution emitted by Illinois coal with a sulfur oxide scrubbing technology or converting coal to a sulfur-free liquid or gaseous fuel that could supply the energy to run electric power plants, automobile, and even household fuel. Our electric plants bring in coal from the western states, such as Wyoming, etc., that have seen fit to place a surcharge on the coal exported to Illinois. This has cost Illinois power users millions of dollars in our light bills, and we find we are unfairly supporting the government of states other than Illinois.

5) The payroll generated by the personnel employed in these two labs contribute significantly to our economy, and as you know, Illinois has an unemployment rate above the national average. In addition, the type of personnel at Argonne has encouraged private industry to settle in the City of Naperville area that is fast becoming a nationally recognized Research Corridor with Bell Labs one and one-half million feet plus labs, the Amoco Research Facility, and Nalco Lab, to mention a few. In my opinion, Argonne and Fermi give our area an improved opportunity to obtain a more equitable return and revenues and technical talent.

In addition, the personnel of these two labs live in the general area and have contributed to both the social and financial well-being of this area.

I strongly urge this committee to impress both the Secretary of Energy and Secretary of Commerce that the irreplaceable national asset we have in these two labs not be lost to the well-being of these United States.

Sincerely,

Chester J. Rybicki
Mayor

sm

Village of Willowbrook
7760 Quincy Street Willowbrook, Ill. 60521
(312) 323-8215

EDWIN C. SCHMITTSCHMITT
PRESIDENT
ROBERTA KRAUSE
VILLAGE CLERK
BERNARD A. OGLIETTI
VILLAGE ADMINISTRATOR

December 28, 1981

Senator Charles Percy
230 S. Dearborn St.
Room 3859
Chicago, Ill. 60604

Dear Senator Percy:

Enclosed please find a certified copy of Village of Willowbrook Resolution No. 81-R-20, "A Resolution in Support of the Continued Operation of Argonne National Laboratory". As you will note, we are indeed concerned about the viability of the continued operations of the Argonne National Laboratory.

We sincerely appreciate your consideration of this Resolution, and if I or the Village of Willowbrook can be of any assistance regarding this matter or other matters of mutual concern, please do not hesitate to contact me personally.

Yours truly,

Edwin C. Schmittschmitt
President

ECS/kmc
Enc.

December 16, 1981

I, ROBERTA KRAUSE, VILLAGE CLERK, VILLAGE OF WILLOWBROOK, DO HEREBY CERTIFY THAT THE ATTACHED IS A TRUE AND CORRECT COPY OF VILLAGE OF WILLOWBROOK RESOLUTION NO. 81-R-20 "A RESOLUTION IN SUPPORT OF THE CONTINUED OPERATION OF ARGONNE NATIONAL LABORATORY".

Roberta Krause

RESOLUTION NO. 81-R-20

A RESOLUTION IN SUPPORT OF THE CONTINUED OPERATION OF ARGONNE NATIONAL LABORATORY

WHEREAS, Argonne National Laboratory is a research facility conducting broad programs in the fields of Energy, Conservation, Environmental Studies and Bio-Medical Sciences; and

WHEREAS, Argonne National Laboratory is operated by the University of Chicago with funding provided by the United States Department of Energy; and

WHEREAS, Argonne National Laboratory is located within one and one-half miles (1 ½) of the Village of Willowbrook, DuPage County, Illinois; and

WHEREAS, for many years Argonne National Laboratory has had a substantial positive impact in the economics of the Local Municipalities and of Southeast DuPage County; and

WHEREAS, the President and Board of Trustees and the citizenship of the Village of Willowbrook, DuPage County, Illinois, are concerned that the United States Department of Energy may be considering a reduction in funding which may impair the continued operation of Argonne National Laboratory.

NOW, THEREFORE, BE IT RESOLVED by the President and Board of Trustees of the Village of Willowbrook, DuPage County, Illinois, that we do hereby support the continued funding of the operations of the Argonne National Laboratory by the United States Department of Energy and view with concern any reduction in funding that would cause the closing of, or drastically impair the operation of the Argonne National Laboratory.

ADOPTED and APPROVED this 14th day of December, 1981.

APPROVED: R Schmitt
President

ATTEST:
Roberta Krause
Clerk

ROLL CALL VOTE: AYES: 7 Conklin DeLorenzo McCabe Roose Seeman Stasell Schmitt
NAYES: 0
ABSENT: 0
ABSTENTIONS: 0